POPULAR SCIENCE

MONTHLY

APRIL

NOW 15¢

See Page 41

NEW INVENTIONS • MECHANICS • MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS • 350 PICTURES

All the Comforts *of* Home!

SEATS ARE LIKE "EASY CHAIRS" IN BIG, NEW CAR THAT LEADS ALL LOW-PRICED CARS FOR RIDING-COMFORT

Just a few years ago, not even the costliest car could match the smooth, luxurious riding-comfort that Plymouth passengers enjoy today. Yet this is one of the lowest-priced cars now on the market.

IT'S AMAZING WHAT ENGINEERS have done to increase the comfort of driver and passengers in modern cars.

Modern weight distribution—which Plymouth pioneered in the low-price field—is only part of it, today.

To balanced weight, this big car adds balanced spring action. Big, soft-acting front springs of "Amola" steel (of maximum flexibility plus great tensile strength) have the same "rate" as rear springs. Rigid frame, double-acting shock absorbers, and a front-end sway eliminator, all aid "Floating Ride" comfort.

The seats are scientifically designed for relaxed body posture... of chair height, properly "pitched," with plenty of room for legs, elbows and shoulders. The beautiful Plymouth is easily most comfortable of "All Three" leading low-priced cars.

The body is specially insulated against all noise. Patented "Floating Power" engine mountings eliminate vibration.

Low center of gravity . . . yet lots of head room and leg room...in "easy chair" seats.

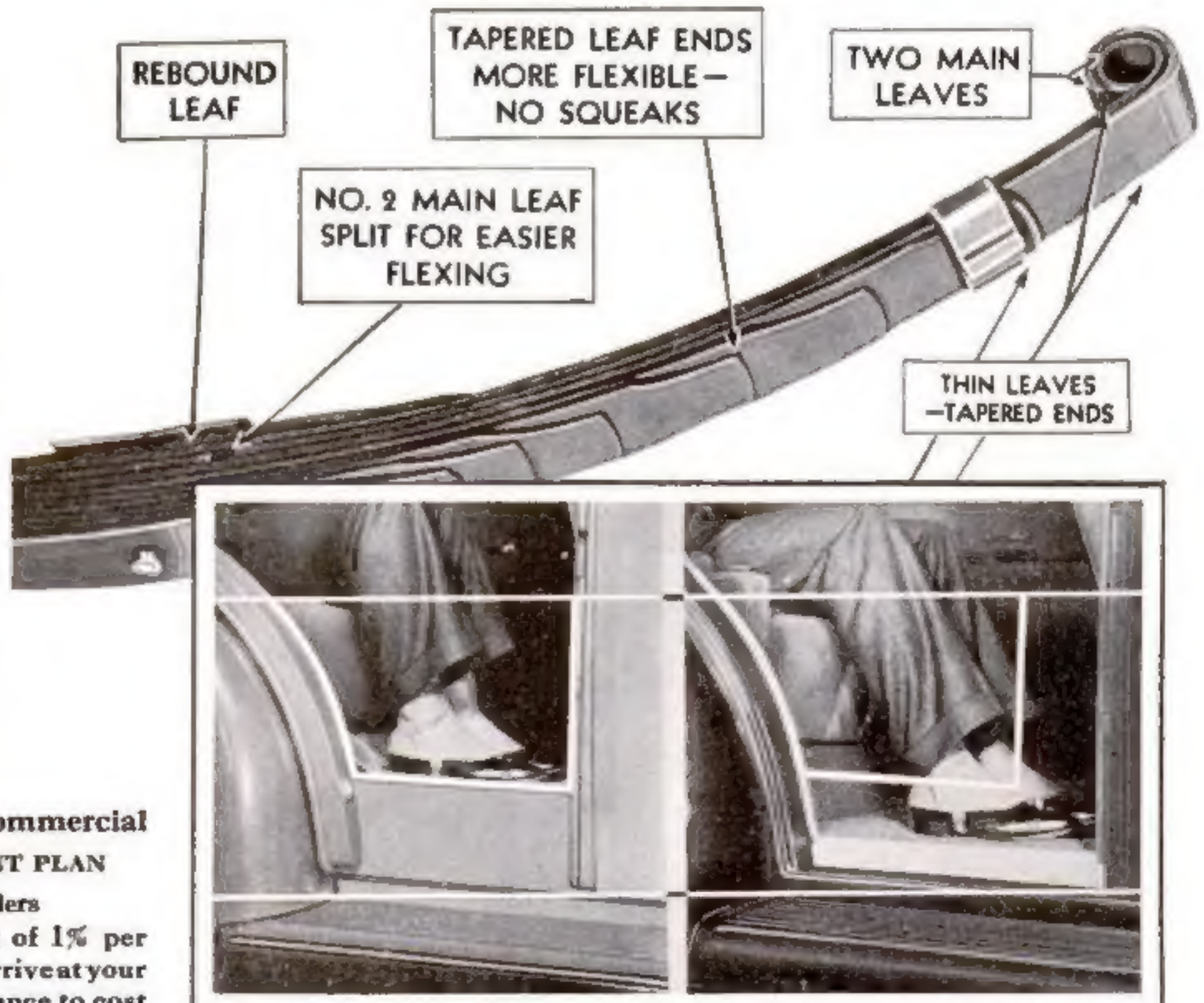
And then there's the mental comfort of knowing that you are riding in the world's safest low-priced car...with 100% hydraulic brakes and a Safety-Steel body.

Drive the 1936 Plymouth. Your Chrysler, Dodge or De Soto dealer will gladly arrange a demonstration for you. Prices are only $510 and up... list at factory, Detroit (special equipment extra).

PLYMOUTH DIVISION OF CHRYSLER CORP.

Old way—unbalanced weight distribution and spring action made rear seat ride like a chip on a stormy sea . . .

The Floating Ride—bounce and pitching ended. Spring action equalized...weight correctly distributed . . . smooth riding.



At left you see the "low seat-high floor" that cramps legs, knees, waist and back. At right, Plymouth's lower floor and chair-height seats...in which even all-day trips are comfortable!

***Insist on the* Official Chrysler Motors Commercial Credit Company 6% TIME PAYMENT PLAN**

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You pay for credit accommodation only ½ of 1% per month on your original unpaid balance. To arrive at your original unpaid balance: 1. Add cost of insurance to cost of car.* 2. Deduct down payment—cash or trade-in.

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FEATURES AND DEPARTMENTS

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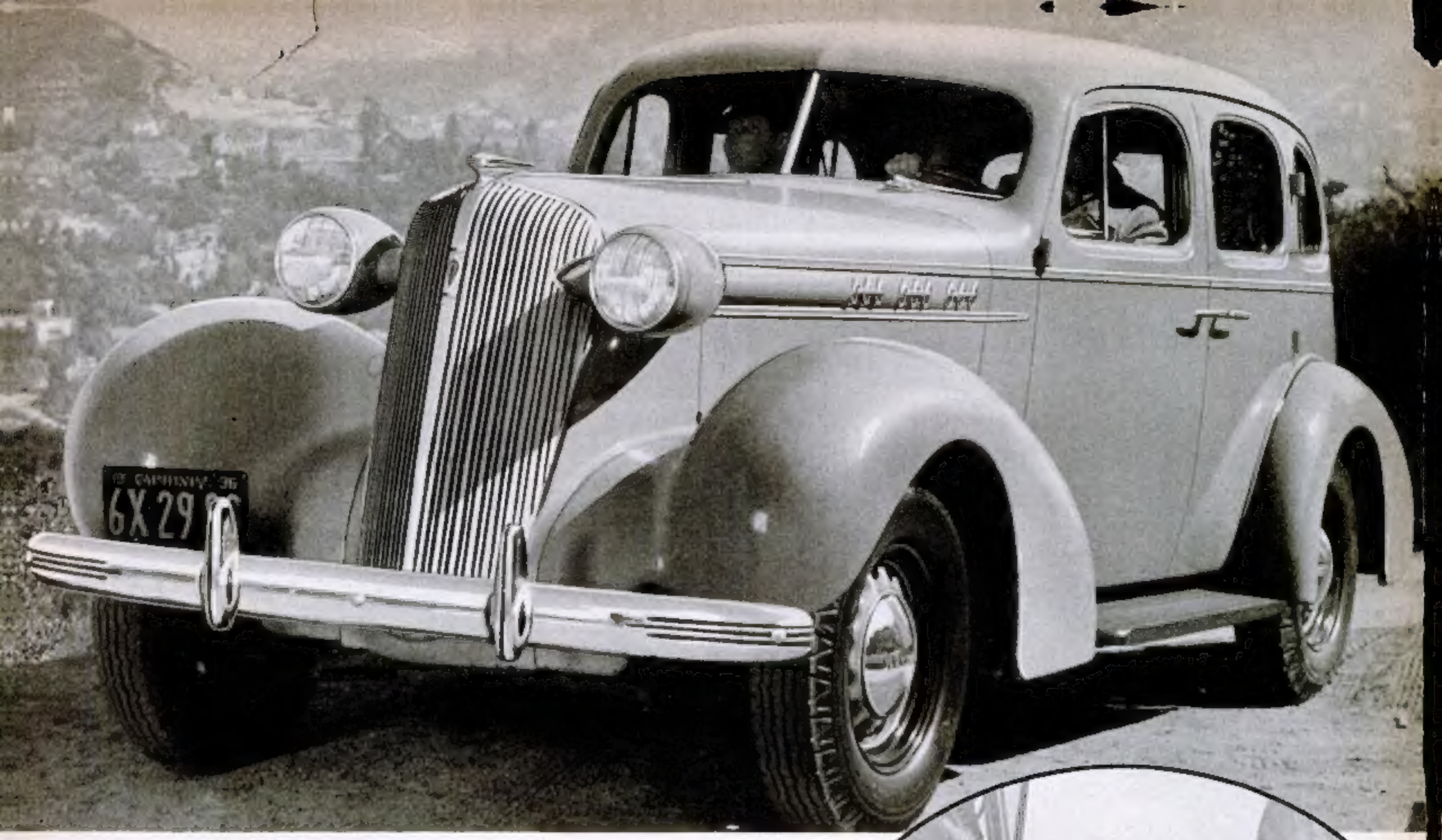
AUTOMOBILES

AVIATION



Advanced Features which contribute to OLDSMOBILE'S GLIDING RIDE

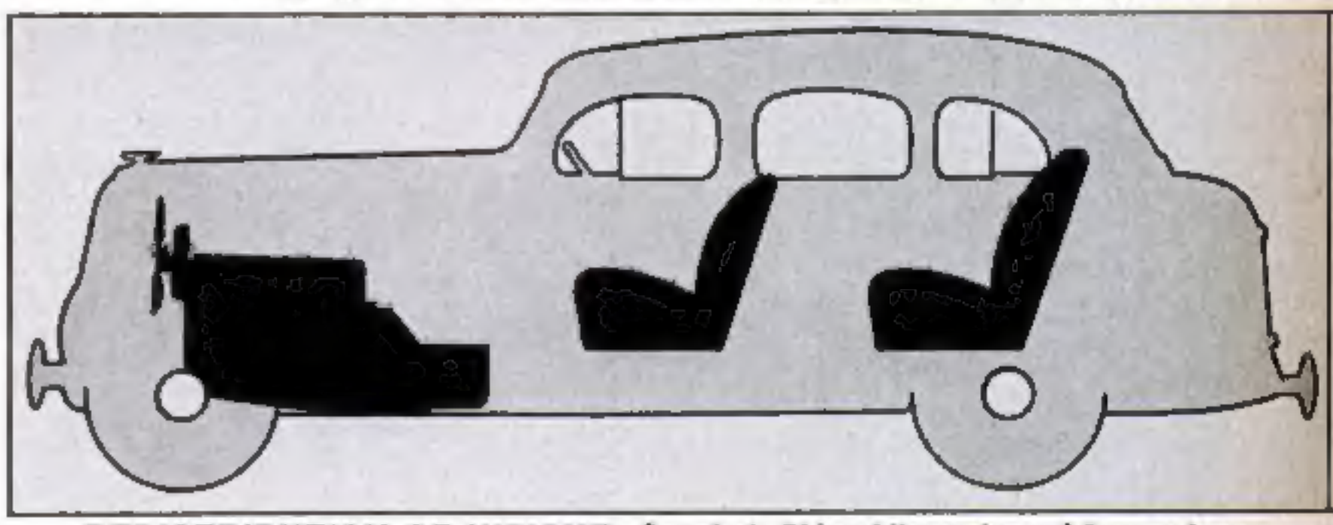
IT IS not by accident that Oldsmobile provides the utmost in a smooth, restful, gliding ride. Oldsmobile's extraordinary riding comfort is the result of painstaking engineering . . . the inter-relating and balancing of dozens of individual comfort features. Several of Oldsmobile's advanced contributions to riding comfort are illustrated and described on this page. For a complete conception of Oldsmobile's gliding ride, write to Olds Motor Works, Lansing, Mich., and ask for a free copy of attractively illustrated Catalog and 1936 Engineering Information.

Sixes $665 and up . . . Eights $810 and up, list prices at Lansing, subject to change without notice. Safety Glass standard equipment all around. Special accessory groups extra. The car illustrated, 4-Door Sedan, $795 list. A General Motors Value. New 6% GMAC Time Payment Plan.

$665

"The Car that has Everything"

KNEE-ACTION WHEELS—Oldsmobile's front wheels move up and down independently of one another to "step over" bumps and holes. Soft coil springs in front act in unison with soft leaf springs in the rear. Both front and rear seat passengers enjoy gliding comfort.



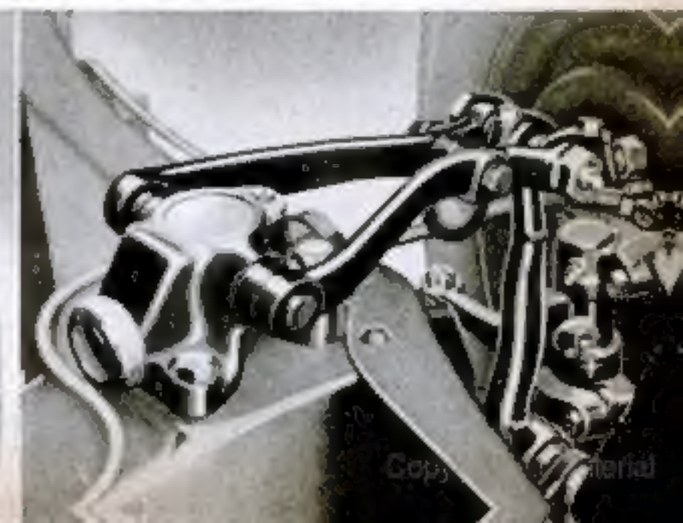
REDISTRIBUTION OF WEIGHT—In today's Oldsmobile, engine and front and rear seats are moved forward in relation to front and rear wheels. This new distribution of load evens up the weight over front and rear wheels and helps to eliminate back seat pitching and tossing.

...IG, OVERSIZE TIRES—Tires on ne Oldsmobile Six are 16 x 6.50" and on ne Eight 16 x 7" in size. Big, low pressure ses mean additional riding comfort; also, ntra traction for starting and stopping.

RIDE STABILIZER—The spring steel bar, connecting rear hydraulic shock absorbers, keeps your Oldsmobile level by a twisting reaction if one side tends to rise . . . controls sidesway and body roll.

CENTER-CONTROL STEERING—All parts of Oldsmobile's steering mechanism, save tie rods, are included with sprung weight of chassis. No road shocks are transmitted. You do not have to "fight" the wheel.

DOUBLE-ACTION HYDRAULIC SHOCK ABSORBERS—Oldsmobile's shock absorbers, both front and rear, control spring action and frame movement in both directions . . . add greatly to riding ease.



POPULAR SCIENCE MONTHLY FOR APRIL, 1936

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

"B.O."—ME? THAT'S A BIG LAUGH

—*look out sir, the laugh is on* YOU

YOU NOTICE "B.O." QUICKLY IN *OTHERS* AND RESENT IT! BUT HAVE YOU MADE SURE *YOU CAN'T* OFFEND?

YOU FIND GIRLS GLAD TO GO OUT WITH YOU *ONCE*. NEXT TIME — NO! YET YOU SCOFF AT THE SUGGESTION *YOU* COULD HAVE "B.O."

DOCTORS SAY WE *ALL* PERSPIRE A QUART OF ODOROUS WASTE DAILY! DON'T TAKE CHANCES —GET LIFEBUOY

ONE BATH AND YOU'RE A LIFEBUOY FAN FOR LIFE!

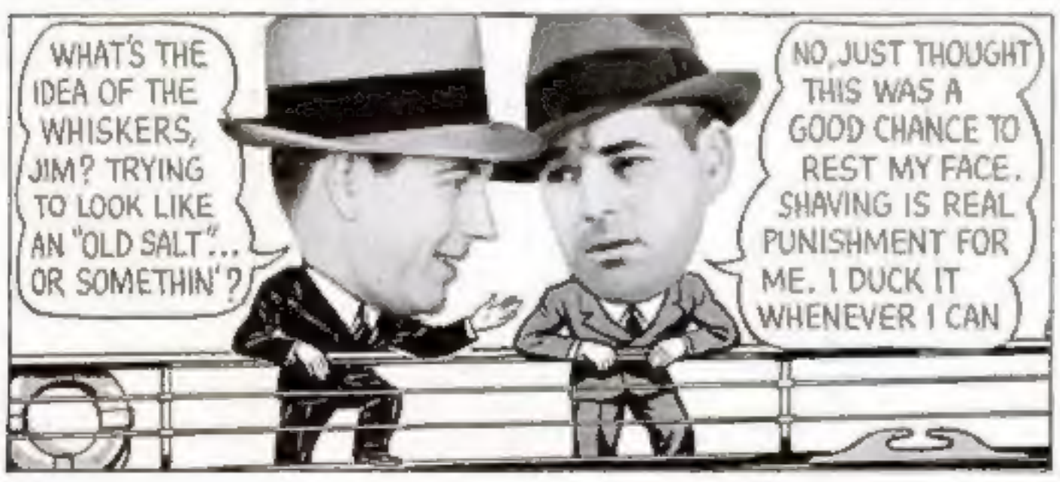
NOW YOU CAN LAUGH AT "B.O."! YOUR COMPANY IS *ALWAYS* WELCOME

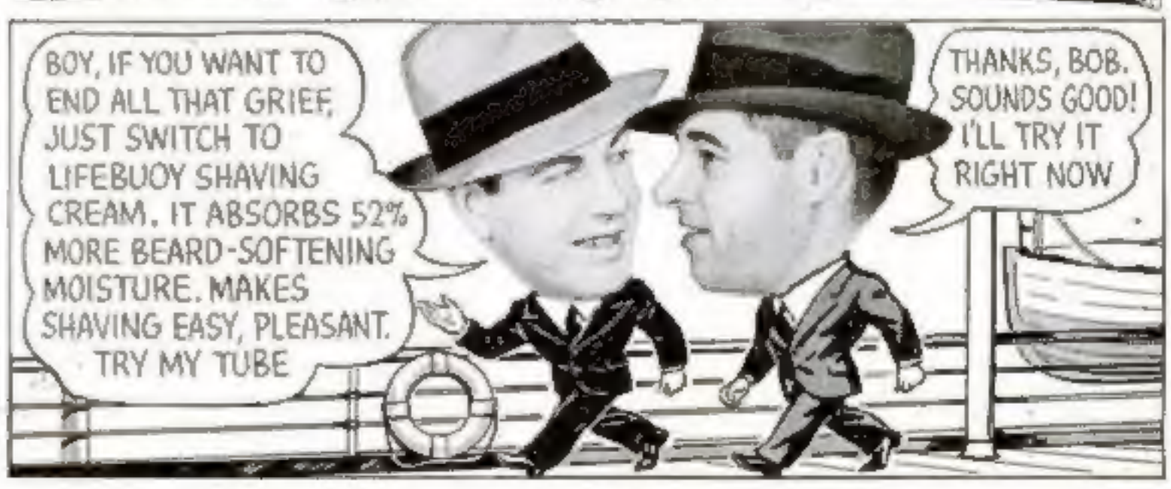
Skin fresher and clearer, too

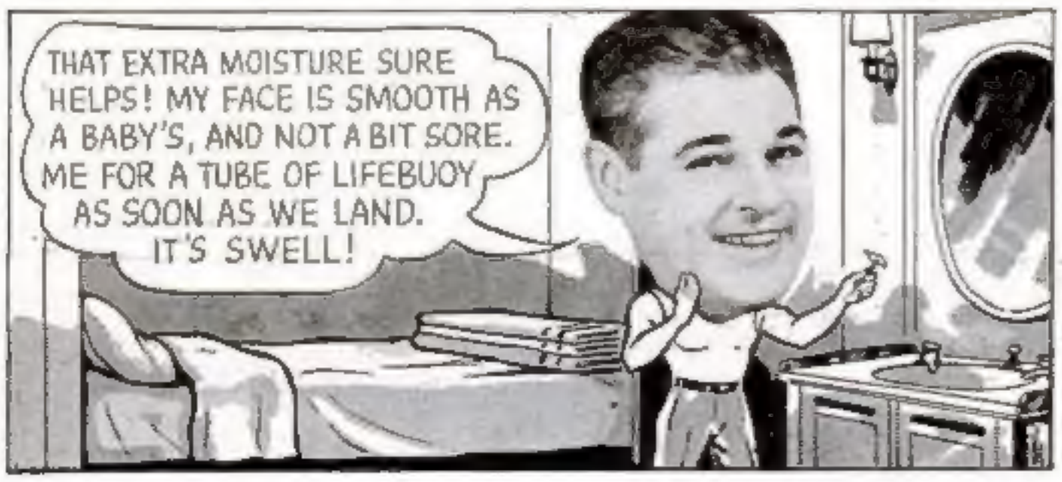
LIFEBUOY'S creamy, searching lather cleanses *deeply*, rids pores of impurities, makes the complexion glow with health. Yet "patch" tests on the skins of hundreds of women show it is more than 20% milder than many so-called "beauty soaps." No wonder women everywhere are discovering that gentle, pore-purifying Lifebuoy is the finest of complexion soaps.

Approved by Good Housekeeping Bureau

IT'S LOTS MILDER THAN OTHER LEADING SHAVING SOAPS







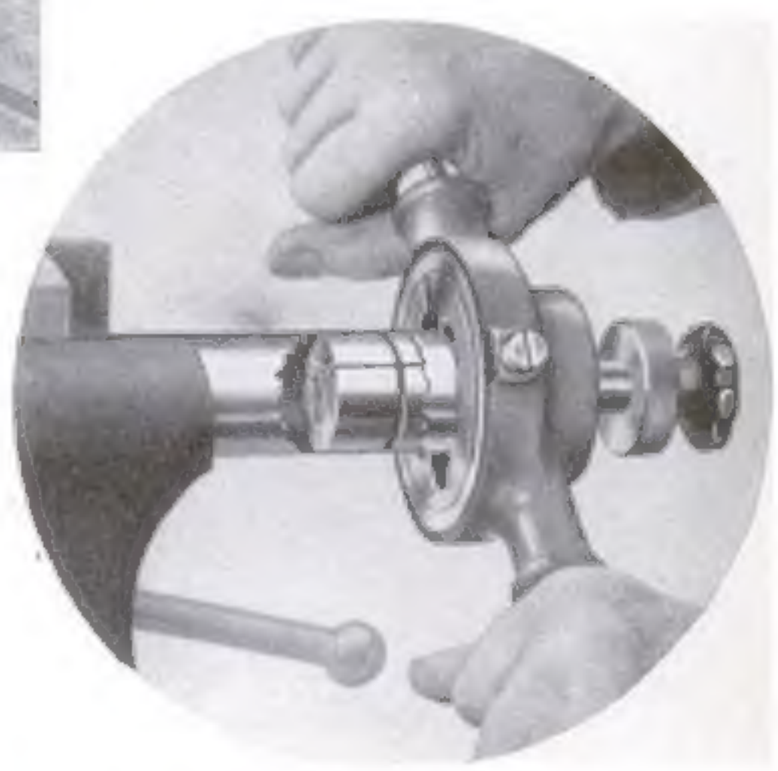
Send for a FREE Trial Tube

Try this mild, soothing, extra-moist Lifebuoy lather—enjoy the extra shaving comfort it offers. Get the big red tube at your druggist's. Or write Lever Brothers Company, Dept. A-144, Cambridge, Mass., for a free 12-day trial tube.

(This offer good in U. S. only)

New Tools *for* Home Repairs

RESEMBLING a shoe-shine buffer, an all-metal sanding block now available makes it easier to resurface floors by hand. Provided with a comfortable handle, the block is easy to use, while an easily operated spring-clip arrangement allows the sandpaper to be renewed with a minimum of trouble. It is necessary only to slip the holder from the handle, bend the new sandpaper over its rounded ends, and slip it back into place. Fitted with a piece of soft cloth instead of the sandpaper, the sander can be converted into a handy applicator or may be used as a polisher for wax.



DIE SET FOR METAL TUBING

WITH the increased use of metal tubing for home-repair work, a special stock-and-die set has been developed for threading the thin-walled "pipe." Provided with an ingenious expansion bushing guide that fits snugly inside the tubing, the tool, it is said, will not scratch, mar, or crush the walls during the threading process. The guide also insures perfect alignment of the cutting die so that accurate threads will be cut even though the edge of the tubing is not a perfect right angle.

HANDY PLIERS KIT HAS MANY USES

ONE of the latest additions to the handy man's choice of tools is a set of four pliers nestled in a convenient metal carrying case. The pliers, of the standard, parrot-nose, needle-nose, and flat-nose types, are four and one half inches long and made of a special alloy steel. Designed especially for use in hard-to-get-at places, they are valuable for electrical, radio, and automobile repair work as well as general household use. Mounted in their compact carrying case, they can be stored easily in the average tool kit.

WRENCH IS SELF-ADJUSTING

ONLY one hand is needed to adjust a new wrench of unusual design. When the user rotates a cam on the side of the tool with his thumb, a coiled spring hidden in the handle closes the jaws to grip the nut. The wrench cannot slip its hold, the manufacturers claim, because it automatically locks in position until the cam is moved in the opposite direction and permits the jaws to be released.

Questions

FROM HOME OWNERS

Q.—HOW can I keep paint from peeling off my radiators? I do not seem to be able to do a paint job that will stand up.—R. K., Washington, D. C.

A.—YOUR difficulty is probably caused by painting the radiators in the fall or winter, when the furnace was operating. This would cause the paint to dry too quickly. Scrape the rust from the metal surface, and paint again. With the heat turned off for the summer, the paint will dry slowly and give a permanent job.

LEAK IN HOT-WATER TANK

Q.—MY hot-water storage tank has sprung a leak through a small hole. Is there any way I can fix it?—A. S., Jamaica, N. Y.

A.—THE leak can be stopped easily by driving a tapered plug of white pine or walnut into the hole. The plug should have a very gradual taper, with the end almost as sharp as a needle. Soak it in water and then drive it in with a hammer. Cut off the projecting end within half an inch of the surface of the tank.

WARMING VARNISH

S. T., VANCOUVER, B.C., CANADA. Varnish that is too cold for effective use can be warmed by setting the container in a pan of warm water and allowing it to remain until the liquid is of the proper consistency.

LOOSE NEWELS AND HANDRAILS

Q.—THE newel posts and handrail of our stairs are loose and wabbly. What is the best way to tighten them?—J. V., Reno, Nev.

A.—FIRST brace the newel posts and handrail securely. This is done by fastening strips of wood against the newel from the angle of the base and floor at both sides, or by placing struts between the newel and the walls. Then nail the underside of the handrail at the starting newel, or the upper side at the landing newel, as necessary; use eight-penny finishing nails, soaped at the points. Also drive nails at the riser, tread, and stringer. Drive all the nails at an angle and set them with a nail set before removing the braces.

USE OF BRUSH IN STENCILING

D. D. S., TOPEKA, KANS. The brush technique of stenciling is easily mastered. Use stenciling colors, which are sold in tubes and can be thinned with turpentine. Pouring a little of the paint on a plate, dip a regular stenciling brush into it and apply to the wall with a twisting motion, holding the brush at right angles to the wall. Never use a brushing motion.

TURPENTINE REMOVES WAX

Q.—WHAT is the best method of removing wax from a floor?—P. A., Des Moines, Iowa.

A.—TURPENTINE removes wax readily. Apply it with a cloth, rubbing vigorously on each section of the floor until the wax has been washed out.

CONCRETE GARAGE RUNWAYS

Q.—I AM planning to lay concrete runways to my garage to replace an unsatisfactory cinder driveway. Can you suggest the proper width and spacing, and the best mix of concrete for this purpose?—A. K., Louisville, Ky.

A.—RUNWAYS sixteen to twenty-four inches wide, spaced fifty-six inches from center to center, make a satisfactory driveway. The latter width is preferable if the drive is long. A mix containing one part of cement, two of sand, and four of aggregate is recommended.

Our Readers Say

Archer Tells How They Make 'Em in Northwest

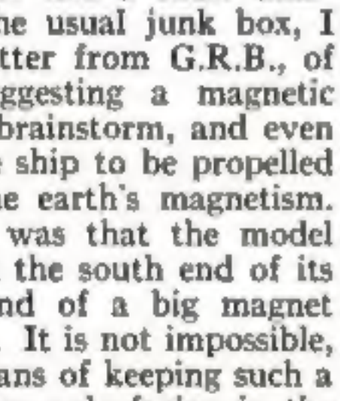
I was much interested in the recent article telling how Howard Hill hunts wild animals with bow and arrow. I would like to see more articles on the making of bows and arrows. I have made about fifteen bows myself. In the Northwest, native yew wood is most widely used for this purpose, although some Osage orange is also employed. I have been told that these are the best woods in the world for bow making. For bow strings, we use salmon twine, and have a method of twisting it together which requires only a few minutes to complete a string with a loop on each end. We do not adhere to the design of the old English bow but make a bow that is a cross between this type and an Indian bow. We believe it is an improvement over the English. Some of our archers make short but very deep hand holds; others use sights. There is witchery in archery and more good articles on the subject, I am sure, would interest many readers.—W.J.McF., Dayton, Wash.

Magnetic Rocket Would Be Good—For Nose Diving, Says Reader

Being an experimenter and a radio amateur (W4ANN) with the usual junk box, I was interested in the letter from G.R.B., of Flin Flon, Canada, suggesting a magnetic rocket. I had a similar brainstorm, and even built a model of a space ship to be propelled by being repelled by the earth's magnetism. The result of the trial was that the model swapped ends and stuck the south end of its magnet to the north end of a big magnet (representing the earth). It is not impossible, I believe, to devise a means of keeping such a ship level with the proper pole facing in the desired direction but, in such event, the ship probably would fly around the globe and bury itself in one of the earth's poles. Or, in its course, it might take a slice off the earth just below the equator. The means for controlling such a ship are so remote that I believe we shall grow rubber spaghetti before we travel by this means.—R.M., Barnesville, Ga.

Thinks British Have Answer To Seat-Cover Question

That letter from Miss R.E.D., of Rochester, Pa., about the desirability of using seat covers in automobiles interested me very much. What beats me is why American car manufacturers don't upholster their car seats with leather just as the British do. Leather is much more hygienic than cloth for this purpose. It needs little attention and besides, in my opinion, it looks far better.—C.A.S., Midlothian, Scotland.



By Way of Wagging An International Tongue

I noticed recently that F.A., of Toledo, Ohio, bemoans the lack of an international language for radio use. The thoughts of F.A. show how easy it is to become steeped in a subject and, at the same time, be apparently unaware of an existing solution to the problem. An already-existing international language, Esperanto, is being used for the announcements of regular programs coming from Berlin, Paris, Vienna, Brussels, Tallinn, Geneva, Stockholm, Moscow, Warsaw, Melbourne, Tokyo, and many other cities. This practice has been in effect since 1928. The Union International de la Radiodiffusione has recommended that its members use Esperanto to announce the time, program, future programs, and all announcements of international interest. The American Radio Relay League is also sympathetic toward the use of Esperanto.—C.F., Meadville, Pa.

Sleuth or Fencer, He'd Meet All Comers

Your magazine, I have come to realize, is one of the finest on the market. For me, it ranks almost as a necessity. Here are a few subjects I should like to see covered in the future: fencing and the making of foils and masks; amateur crime detection, especially the phases connected with microscopy and chemistry—these last two departments are, to me, the high spots of the magazine. Keep up the good work in these two truly popular sciences.—G.P.R., Roanoke, Va.

Suggests Steam Cars Get Another Trial

Like many other readers, I am an ardent steam-car fan and would appreciate a full article on the subject of steam cars. Why steamers are not yet in use is a question which puzzles me, considering their many advantages. Some of the last steam cars built (1926) would compare favorably, indeed in some ways surpass, our modern 1936 models. Very early in automobile history—1907, I believe—a steam racer attained a speed of 120 miles an hour. The highest speed possible for a steam automobile can only be guessed, for the story was current sometime ago that one of the makers of steam cars had a standing offer that whoever would "open up" one of their models would receive the car as a gift. The offer, it is said, was never taken up. The danger of explosion experienced in the earlier models was entirely eliminated with the improvement of the boilers. The steamers, without transmissions, clutches, electric ignition systems, had very few moving parts—about thirty including the wheels. They stood up well and were economical to operate. The pick-up of steam cars, as illustrated in Martin Bunn's article in the May 1935 issue, surpassed that of the newest models and they had twice the horsepower of high-priced gasoline cars.—F.L.G., Birmingham, Mich.

Maybe It's the Viking Spirit That Sends Lemmings to Sea

O.R., of Minneapolis, wrote recently that "Norway got a raw deal when the animals were distributed on this planet." As a matter of fact, Norway, as far back as anyone knows, has been blessed with an abundance of animals—elk, reindeer, deer (hjort), bear, wolf, and hare. Her bird life, on land and sea, is prodigious. The lemming which O.R. calls the only native animal of Norway has given zoölogists cause for much speculation. The persistent westward migration of this animal has suggested the theory that it originated in a region now covered by the Atlantic Ocean (Atlantis) and the migratory instinct to return to its home is still dominant. Maybe this strange occurrence explains, partly at least, the westward-ho inclination of the Norwegians themselves—they just want to find out where those pesky lemmings go.—L.L., Atlin, British Columbia, Canada.

Dishes in His Auto Trailer Just Go to Pieces

Your magazine seems to reach a great many readers with an inventive bent who like to figure out ways of helping their fellow men. Well, here's one fellow who needs helping. Dishes, unless made of metal, and crockery are, as everyone knows, relatively fragile. Auto trailers while in tow, on the other hand, are not without vibration and an occasional and sudden jarring. My problem, as you must have guessed, is to devise a plan which will keep the dishes from breaking in my camp trailer while traveling. I am very anxious to learn of some effective scheme for doing this.—C.T.L., Detroit, Mich.

Accenting the Popular In "Popular Science"

Two letters printed on the Our Readers Say pages of the February issue, I notice, are from readers wishing more advanced articles on scientific subjects—too scientific, perhaps, for anybody but a college professor. I say, leave that kind of stuff for the magazines published for college professors. Keep your magazine as it is so that people like myself can have at least one publication they understand and which covers the field adequately. Again, I say, leave Popular

SCIENCE MONTHLY as it is and leave out such suggested bunk as advocated by these writers. —I.S.M., Madison, Wisc.

Lady Coppersmith Makes a Motion

FOR more than two years, I have been taking POPULAR SCIENCE MONTHLY and I am very much pleased with it. Your articles on radio, craftwork, and photography have been very helpful. I would especially like to see some articles dealing with copper craftsmanship. There are a great many people, women as well as men, who are working with this metal today and find that it offers both an appealing and useful hobby to be followed in their spare time.—(Miss) F.P., Trenton, N. J.

This Pipe Organ, It Seems, Should Keep Them All Quiet

FOR a number of years I have been a reader of your magazine and have been interested in what the readers have to say as well as what appears on the other pages. I noticed in the February issue that E.L.J., of Kankakee, Ill., asked for plans for a pipe organ: another reader, P.R.F., of Springfield, Ohio, wants a plan for an electric pick-up phonograph, and others wish more radio plans. Why not satisfy them all? The pipe organ is being replaced by the electric organ which operates on principles of the radio. I would like to see plans for one of these. A pick-up phonograph could feed into the same amplifier and loudspeaker so these plans should satisfy the radio enthusiast who wants to try something new. Since many of your workshop followers lack power to operate their tools, why not be helpful and publish plans for building electric motors and electric clocks? Then, if these are not enough to fill your available space, print a plan for P.R.F. who also wants a running-board electric refrigerator for use while he and his family are touring.—A.P.C., Rumney Depot, N. H.

He Would Build a Windmill To Stop His Wife's Scolding

HAVING been a reader of your magazine for the past eight years, I thought it about time you heard from one of us "blue noses." With this sort of an introduction you might think I was ready to find fault but I'm not. At long last I've taken the time to write you. I have read all kinds of letters from the world over, telling what they like and dislike (give them all a chance), but for my part, I'll take the home-workshop department. In this connection, how about an article during 1936 for the construction of a homemade windmill? The wife gets after me about burning so much juice and, as others may run into the same situation, I thought a windmill might help us out and keep the women quiet for a while. I would like to see plans for one that will develop about three quarters or one horsepower. I had mighty good results in working with other plans received from you last year. I made a rowboat from these specifications and used it on hunting and fishing trips. On one of these, I transported a moose weighing about 500 pounds in it. As I weigh 180 pounds, you can see that the boat carried quite a load.—N.J.C., Bridgewater, Nova Scotia.

When We'll All Live In the Underworld

THE cover subject of your March number called to my mind, rather vividly, a mental picture of the future as recently portrayed by an English writer. It was this. Thousands of millions of years from now the heat of the sun may fail and our entire planet may be ice covered. The coming of this perpetual ice age would be foreseen by the earth's inhabitants and, as a consequence, means would have been evolved so that the human race could adapt itself to such a change. The population, the writer suggests, would live in great underground cities. Ultra-violet rays would be the source of perpetual "sunshine." The seasons, if any changes were desirable, would be under the control of scientific dictators. Food and clothing would be products of chemical skill but plants and animals could be raised in these underground areas. Abundant energy might be obtained from the transmutation of matter. Or, as suggested by your cover, giant windmills might stud the surface of the earth and supply some of the needed power. Such a civilization, the writer further intimates, may already be in existence on some planet, such as Mars or Venus, or other far-remote world out in cosmic space.—M.J.C., Newark, N. J.

Ventriloquist Speaks For a Silent Partner

INASMUCH as you run articles on the making of marionettes, I wonder if you would give the amateur ventriloquists among your readers an article on the construction of a ventriloquist's doll or dummy. Many of us who follow this hobby have home workshops where we could turn out a suitable model with little difficulty.—J.H.O., Ottawa, Canada.

Try This, Suggests Reader, On Your Chemical Flask

HERE is a suggestion for making excellent containers for hot or cold liquids which might interest some of your readers. I took heat-resisting chemical flasks of 500 and 1,000 cubic centimeter capacities and wrapped the necks with friction tape. Over this covering, I wound cane, about three thirty-seconds of an inch in width such as is used for caning chairs. In winding the cane, both ends were secured under the turns. Next, I applied vermilion, orange, and blue paint in stripes (any colors may be selected) for decoration. Finally a coat of varnish was applied over the dried paint. Varnish was also applied to the cork, but on the top only. As these flasks are heat-resisting, they are more than decorative; they may be placed on a stove for heating.—P.O. J., New Bern, N. C.

A Home Sweet Home For the Bees

IN REGARD to the request of B.F.O., of Mocassin, Ill., for the plans for a model beehive, my answer is that such hives are not obtainable commercially because modern beehives are manufactured with more attention paid to profits than to the comfort of the bees. In my opinion, a model home for bees should have a six-inch clearance space on all sides and at the top and bottom—between the honey racks and the hive walks. Bees live in highly organized families. The added space I have mentioned keeps the colony from overheating (air conditioning), lessens the possibility of disease, and enables the bees to defend themselves better. The hive should have an extended roof to protect the side walls. The exterior of the hive should be painted with aluminum paint but no paint should be used on the interior. When the bees come in from the fields, they are heavily laden and exhausted. Therefore, a landing board, at least six inches wide, should extend across the front of the hive. Otherwise, some bees may fall to the ground where they become prey for poultry and toads. Any style of honey frames may be used but the hives should be two stories high with a screen between floors to prevent the queen from entering the second story and laying eggs in the honey cells.—E.W., St. Louis, Mo.

With Road-Gripping Brakes, He'd Stop All Cars

LONG hours of recovering from an automobile accident caused me to think how similar accidents and many others could be prevented. In my case, the automobile which struck me could have been stopped and the accident avoided if the car had been equipped with drag-shoe brakes, capable of digging into ice or snow. Two or four of these brakes suspended in position under the car and having their action synchronized with that of the brake pedal and lever would give positive braking action (no skidding) to a car on an ice or snow surface. Built like sled runners in shape, these drag shoes would be raised when released from action. When thrown into action, they would grip the road surface by direct contact. Present automobile brakes are psychologically wrong, as well as mechanically inadequate, on ice or snow surfaces because drivers through years of reliance on them under good conditions fail to make the needed allowances for their inefficiency under bad conditions.—D.H.S., Flint, Mich.

With No Burden to Bear, No Wonder He Laughs

AS A reader for many years, I am dropping you a line. I would appreciate more articles about boats and their construction, a subject of great interest hereabout. Your model boats have been fine. I also follow your articles on craftwork and enjoyed those on marionettes very much. Sometime ago, in the September number of last year, L.K., of Topeka, Kans., wrote that we have no beasts of burden among our native animals. That may be so but those that we have command attention in other ways. Our kangaroos make many so-called speedsters look sick, while the laugh of our kookaburra is a new one for the rest of the world. The kookaburra, in case you do not remember your zoölogy, is sometimes called the laughing jackass. This name is misleading because the creature is not an animal but a bird—a member of the kingfisher family. Our koalas, looking like real Teddy bears, are in a class by themselves.—W.B.B., Chatswood, Australia.

Wants To Make His Own Test Set

BEING an old subscriber (nearly eight years) and reader of your magazine, I want to tell you that your choice of articles has been excellent. I would like to see published in the magazine an article or articles on making a good ignition test set for automobiles from parts to be constructed or which are easily available. I can assure you that such an instrument would supply a much-needed accessory. I will appreciate seeing plans for it soon.—G.N.J., Indore City, India.

Lining That Lasts

Chevrolet uses exceptionally fine materials throughout its braking system. Brake linings are tough and long-lasting.

Doubly Durable Shoes

In each Chevrolet brake, two shoes hinge on double articulated links. When the brakes are applied, this double joint effect permits each shoe to move in the direction of the moving brake drum in such a manner that its surface bears uniformly for its full length on the curvature of the drum. This design assures uniform wear with resulting long life.

Swift Action for Safety

The hydraulic pressure which actuates the wheel cylinders of each brake operates according to the fundamental law of physics which states that "pressure exerted upon a column of liquid is expended equally in all directions." Due to the extremely short distances the pedal, fluid and shoes travel, equalized braking is accomplished almost instantaneously upon brake application. A hand brake system, functioning mechanically, operates entirely separate from the hydraulic service brakes and gives the last full measure of safety.

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You Need Chevrolet's

NEW PERFECTED HYDRAULIC BRAKES

for Safe Driving

MASTER DE LUXE SEDAN

. . . and you also need *all* these other vital features exclusive to Chevrolet in its price range

Solid Steel one-piece Turret Top Body . . . Improved Gliding Knee-Action Ride* . . . Genuine Fisher No Draft Ventilation . . . High-Compression Valve-in-Head Engine . . . Shockproof Steering*

IT DOESN'T pay to take chances with your own safety and the safety of your family. Only the absolute limit of motoring protection should satisfy you. And that kind of protection is provided, in the low-price field, only by the 1936 Chevrolet with *New Perfected Hydraulic Brakes.*

These brakes are the *smoothest, surest, safest* brakes ever developed. They give the new 1936 Chevrolet unequaled stopping-power. They respond to almost unbelievably light foot pressure. And, best of all, they are one hundred per cent reliable under all driving conditions.

To the *quick-stop protection* of these new perfected brakes, Chevrolet adds the *all-round protection* of a *Solid Steel one-piece Turret Top;* smooth, steady *Knee-Action Ride*; Genuine Fisher No Draft Ventilation;* quick-accelerating *Valve-in-Head Engine;* and *Shockproof Steering**—all of which are exclusive to Chevrolet in its price range.

Buy one of these new 1936 Chevrolets and you will get *the only complete low-priced car,* as well as the more thoroughly *safe* car which you and your family have every right to demand.

CHEVROLET MOTOR COMPANY, DETROIT, MICHIGAN

**Available in Master De Luxe models only. Knee-Action, $20 additional.*

CHEVROLET *The only complete low-priced car*

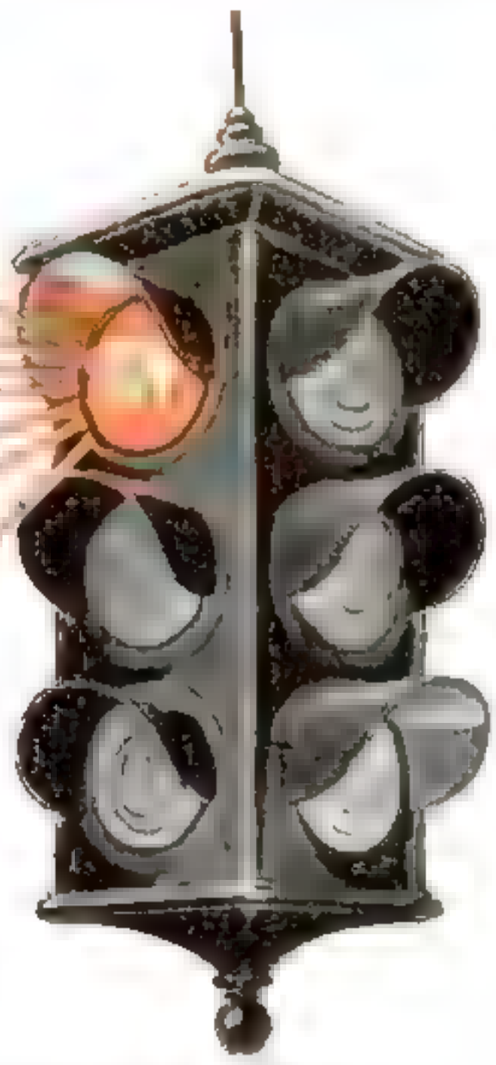
POPULAR SCIENCE Monthly

APRIL 1936 VOL. 128 No. 4

RAYMOND J. BROWN, Editor

Death Gets the RED LIGHT

WITH NEW UNIFORM TRAFFIC CONTROL



Scientific Research and New Safety Devices Help Make Our Highways Safer

By

JESSE F. GELDERS

A FEW weeks ago, mail men delivered more than 100,000 ballots to the homes of American motorists. From coast to coast, the car owners sent them back, indicating their attitude toward proposed plans for reducing accidents. Ninety-five percent favored one immediate step: Making traffic rules uniform throughout the country.

Even a short drive, today, reveals a confusion of signs and regulations. You can make a right turn on a red light at one corner; you can't at another. You see one sign: "Speed limit 20 m.p.h." and another fifty feet farther on: "Entering Blankville. Slow down to 30 m.p.h." You find a town in Maryland with a speed limit of twenty-two miles an hour on one side of the main street and forty-five miles an hour on the other! The city has posted the first side; the state the second.

In Kansas, you can get a driver's license at the age of thirteen; in Oklahoma, you have to wait until you are twenty-one. In Idaho, the maximum legal speed is thirty-five miles an hour. Cross the line into Washington and it becomes forty miles an hour; cross the line

An example of the wide variety of signs used in a single area. The uniform code sets standards

Weatherbeaten warning signs like this endanger life. By careful tests, traffic-control experts select paints that have high visibility and withstand the effects of weather

into Utah and it is fifty miles an hour; cross into Nevada and there is no limit!

Confusion, contradictions, absurdities leave the driver's head swimming. Most arrested motorists, officers report, are not willful offenders. Bringing order out of the present chaos in traffic regulation will mark a long step toward greater safety on the roads.

At this writing, the inventor and the scientist have joined forces with the traffic officials to achieve this goal. Roadside laboratories, windows with blinking shutters, motion-picture cameras riding on the headlights of experimental cars, have played their part in the recent work.

EARLY this year, the Accident Prevention Conference, held at Washington, D. C., announced that it had worked out a uniform code of laws for adoption by all the states. At about the same time, a joint committee of experts representing the American Association of State Highway Officials and the National Conference on Street and Highway Safety, made public details of uniform traffic-control devices which have been approved by the American Standards Association.

Thus, for virtually the first time, officials everywhere are offered carefully worked out plans which, if adopted, will be understood by drivers and pedestrians anywhere in the country.

Behind this advance, I recently learned by going over the various reports and by talking to men who sat on the committees, lies a fascinating story of ingenious tests and research. It is this scientific foundation which now makes uniform codes possible. Specially built apparatus, the same tests made thousands of times motor cars that were laboratories on wheels, contributed bit by bit to solving problems and forming the new proposals.

A number of years ago, investigators in two eastern states set out to find what colors are best for highway signs. They took hundreds of photographs of road signs under varying conditions of light and weather. Comparison of the negatives indicated that black and white made the most conspicuous signs. Consequently, this combination came into wide use.

Then, scientists pointed out that a photographic plate and a human eye do not always react the same. Black on white was best for a camera plate. But was it the most effective combination for the eyes of a driver?

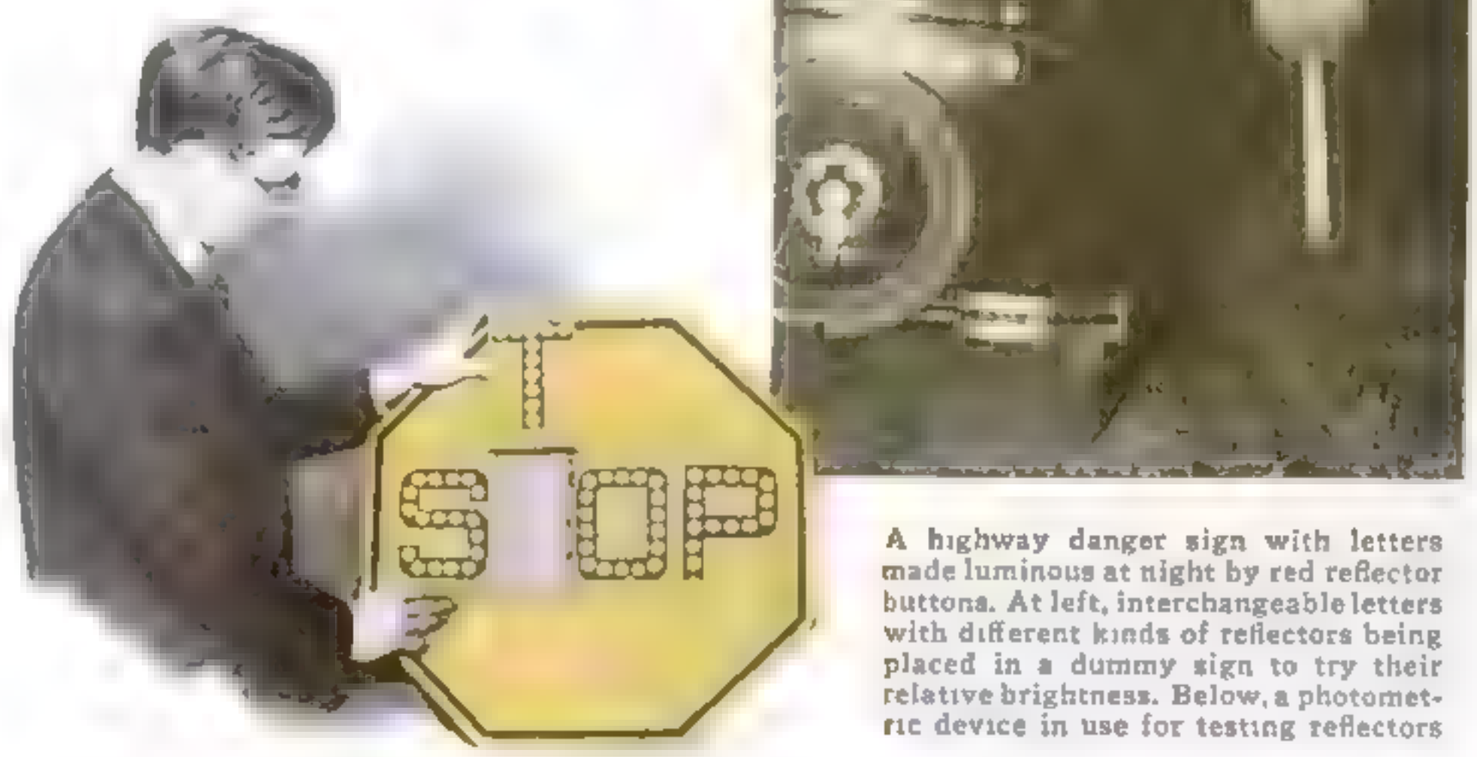
Before that question was finally answered, the U. S. Bureau of Standards spent more than a year in research. Experts designed a curious portable booth, mounted on casters and equipped with headlights. A small window pierced the front panel of the screen. By means of a tachistoscope, a scientific apparatus for viewing objects for brief intervals, the subjects looked ahead through this opening.

One hundred and twenty-one drivers took their places in the booth. Their ages ranged from seventeen to seventy. Three were color-blind. All received fleeting, carefully timed glimpses of signs painted in different colors and placed at varying distances from the testing booth. Swinging along a sort of switchboard, a pendulum operated electrically controlled shutters. As it touched one electrical contact, an electromagnet flipped open the shutter, enabling the subject to look ahead. As it touched another, a second shutter snapped across the window, shutting off the view. The regular swing of the pendulum made it possible to measure an observer's glimpse in tenths of a second. After each snapshot glance, he was asked to give the shape and message of the sign.

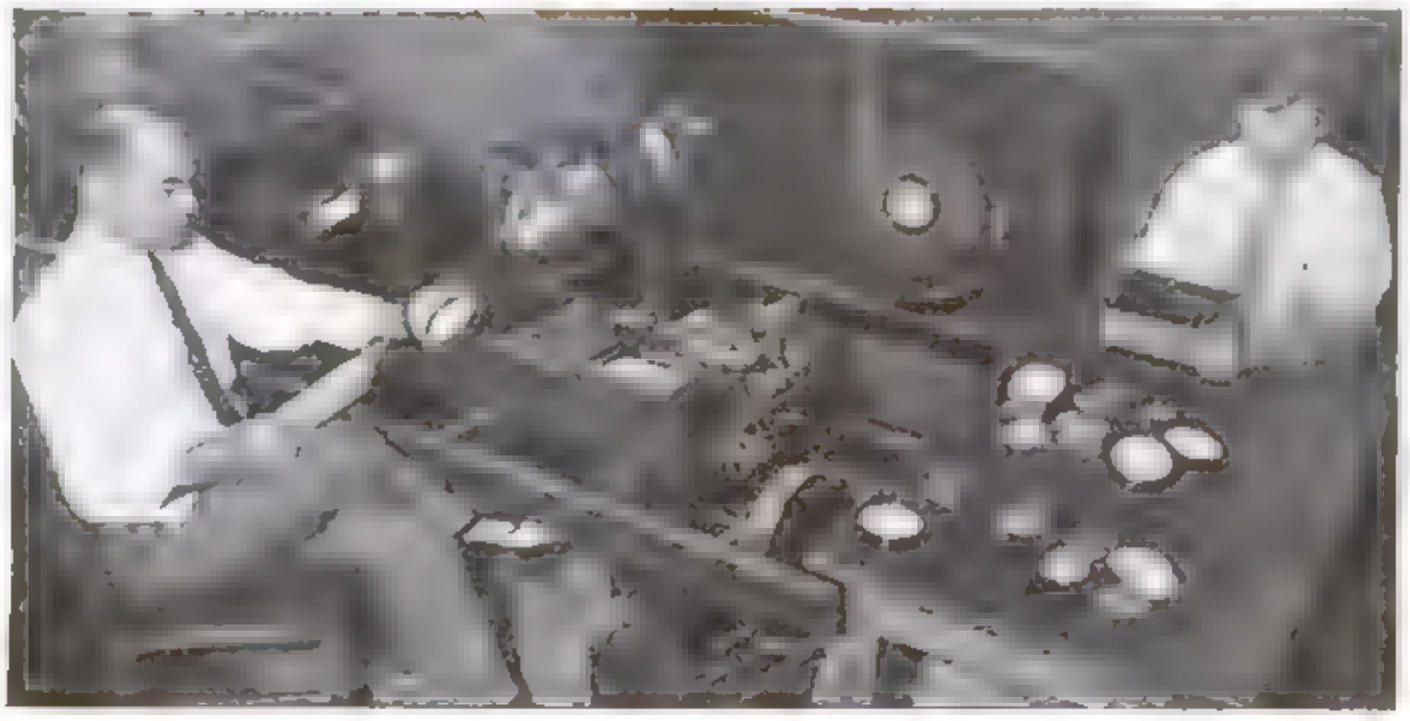
WITH the sun at all angles, with snow on the ground, with spring, summer, and autumn foliage on the trees, with headlights illuminating the signs after dark, the observations were taken over and over again. Before the researches were complete, more than 8,000 of these "eye snapshots" were tabulated.

The results were worth the trouble. They showed that yellow signs with black letters were easiest to distinguish, and read. White letters on black came next, and black letters on white—the familiar combination adopted after the camera tests—came last!

Largely as a result of these tests, the nation-wide color for stop signs is "Federal yellow." These signs, under the uniform code, are to be octagonal. Each type



A highway danger sign with letters made luminous at night by red reflector buttons. At left, interchangeable letters with different kinds of reflectors being placed in a dummy sign to try their relative brightness. Below, a photometric device in use for testing reflectors



of sign is to have its distinguishing shape so it can be recognized even before the lettering is visible.

Not long ago, in the Middle West, an automobile crashed into the back of another machine which stopped suddenly at an intersection although the light was green. The first driver had become confused by the word "Stop" painted on the pavement and had slammed on his brakes.

One of the provisions of the new code is that the word "Stop" is never to be placed on the pavement except where a stop is demanded at all times.

A remarkable feature of the code is the fact that the experts have considered human psychology as well as the problems of streets, hills, and brakes. They have taken into consideration the reckless driver as well as the careful one.

It would be easy to say: "When in doubt, install signal lights or a traffic sign." But previous surveys have revealed that unwisely placed signals sometimes increase accidents thirty percent or more. The "Stop" regulations often are violated by drivers who have become impatient at too many unnecessary delays. Never, states the committee, should signal lights be placed where a "Stop" sign would be adequate; never should a "Stop" sign be placed where a mere warning would serve.

HOW can you tell what is needed for a given place? Exact, scientific formulas are provided. For example, signal lights are recommended for crossings entered by more than 1,000 vehicles an hour, for eight hours, if at least 250 of them come from the less important street and require a "Go" signal a quarter of the time, or if at least five vehicles a minute make a left turn during the heaviest traffic hour.

For five situations, and no others, are "Stop" signs recommended. These are at intersections with main highways, at dead ends of roads, at railway crossings or drawbridges where stops are required, at unsignaled intersections in signalized areas, and at intersections where they are made necessary by restricted view.

From portable booths like the one seen below, autoists were given brief, timed glimpses of experimental signs set up at a fixed distance, as at the left. By this means, visibility was determined

There is no guesswork about restricted views. Mathematical calculations are made on the basis of braking distances and angles of vision. If the figures show it is safe to enter the crossing at a speed of more than eight miles an hour, there will be no "Stop" sign.

In the proposed code for standardizing traffic signs and devices, even the simplest details have their scientific basis. For example, the kind of paint and the sort of bolts to be used are specified. Careful research has shown the paint that wears best and reflects the most light. And, because accidents and near-accidents in the past have been traced to streaks of rust obscuring the letters of a warning sign, the bolts are to be of rustproof metal.

Still other scientific tests produced the specifications for signal lights. The glass in the "Go" light cannot be just any shade of green. The tint, "admiralty green" is very close to blue. The reason for the choice is that many color-blind persons, who cannot tell pure green from red, can distinguish blue.

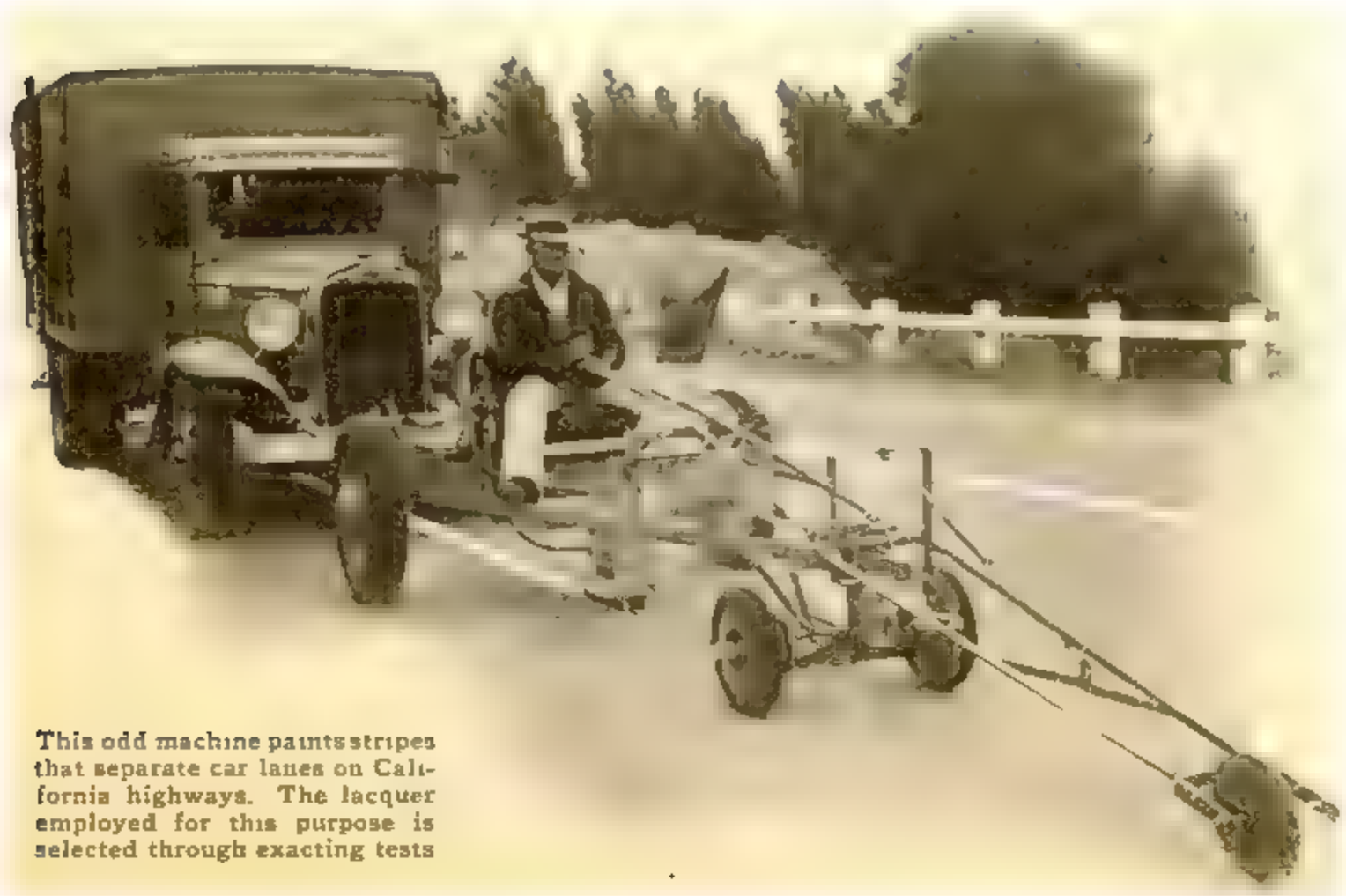
In addition, the code provides that the red light shall always be on top and the green on the bottom. Where special conditions make a horizontal arrangement necessary, the red light is to be at the left and the green one at the right. In all traffic signals, there are to be green, red, and amber lights. The amber is to follow the green, but, never to follow the red as it does now in many cities. To stopped traffic, the signal will stay red until it turns green. No car is to enter any intersection or make any turn against a red light. If any movement is permitted on red, there will be a special auxiliary lens, lighted at the same time, with a green arrow indicating the direction.

Signals are to be placed on the right-hand side of the street on the far corner from the traffic to be controlled. Each lens, when lighted, must be visible at all distances from ten to 300 feet, at all times of day or night, except in dense fog.

ANOTHER rule is that signals are to control traffic at their own crossings only. In many cities, motorists are required to obey signals several blocks in advance. The system is condemned as dangerous. Thousands of drivers, unfamiliar with the rule, have faced arrest for passing unlighted corners.

At no time is a signal to be "turned off." But when, for two or more consecutive hours, traffic fails to justify using a signal in the regular way, it is to be operated as a "flashing light." When it flashes amber, it means "Slow." If the safe approach speed is less than six miles an hour, the red light is to flash. It is the equivalent of a "Stop" sign.

Wheel tracks in the snow, as well as engineering calculations, helped solve a problem in connection with "safety islands" for pedestrians. Such safety *(Continued on page 123)*



This odd machine paints stripes that separate car lanes on California highways. The lacquer employed for this purpose is selected through exacting tests

Push-Button Museum

SHOWS SECRETS OF SCIENCE

By Sterling Gleason

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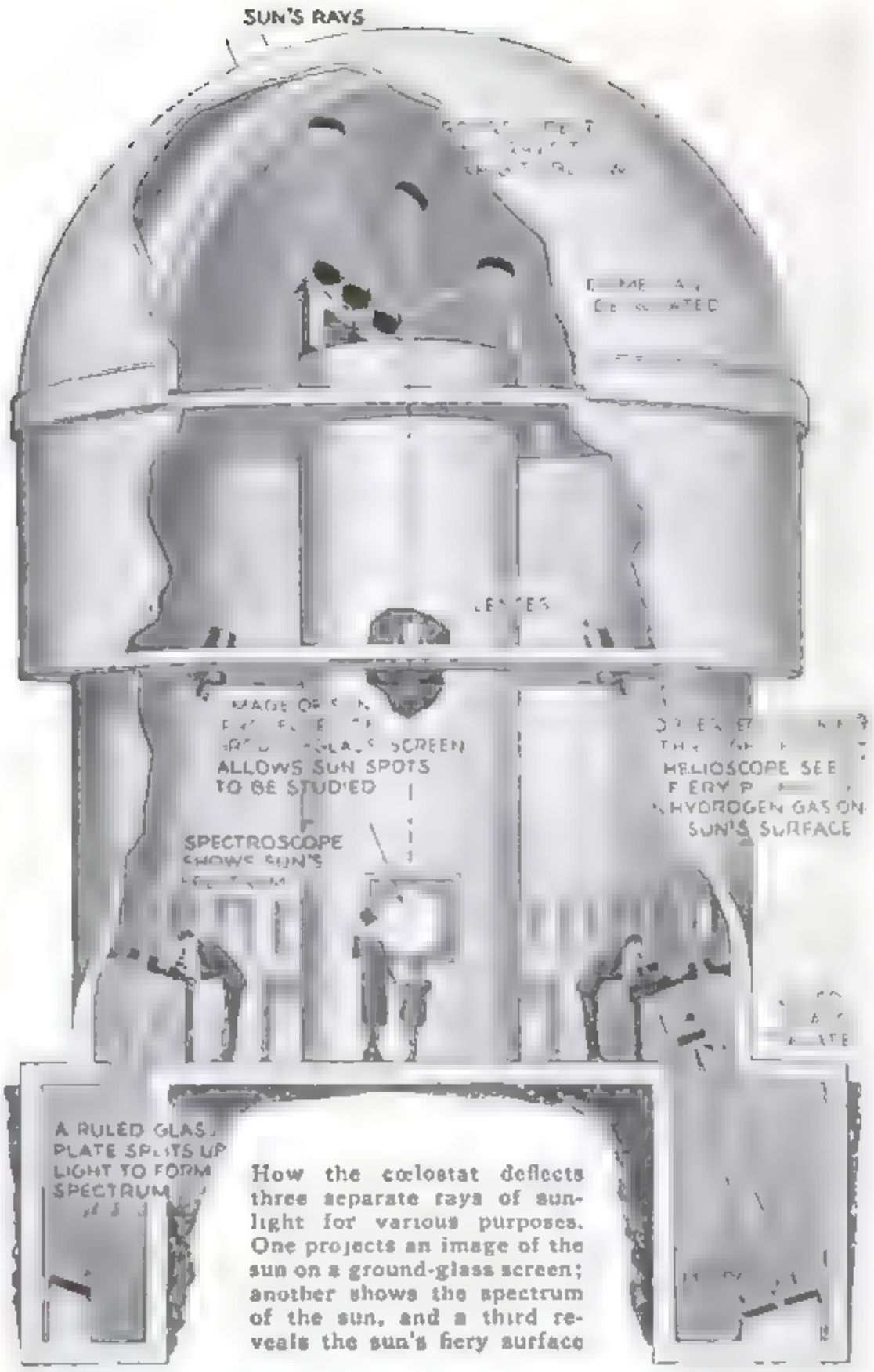
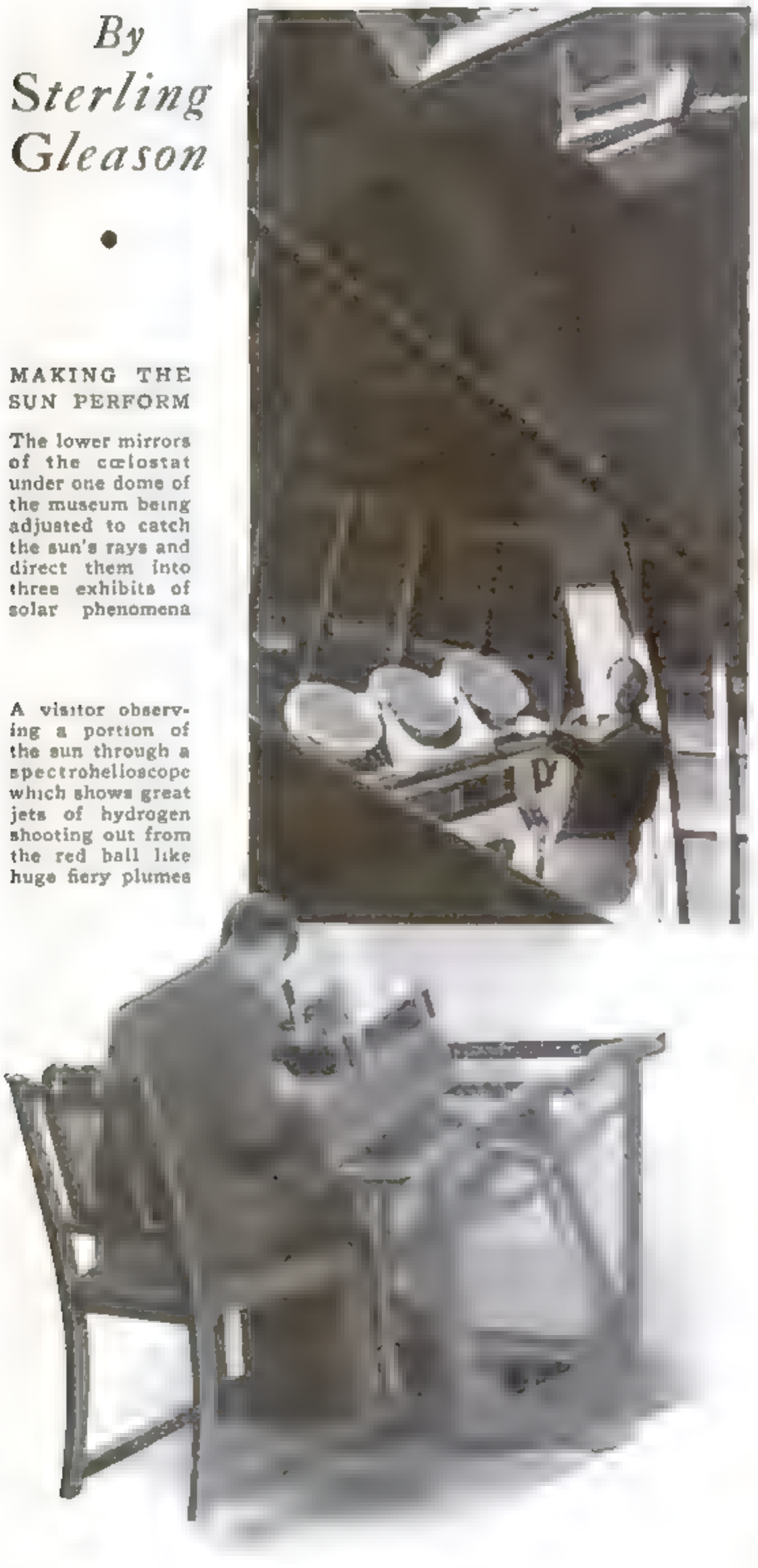


How the cœlostat deflects three separate rays of sunlight for various purposes. One projects an image of the sun on a ground-glass screen; another shows the spectrum of the sun, and a third reveals the sun's fiery surface



MAKING THE SUN PERFORM

The lower mirrors of the cœlostat under one dome of the museum being adjusted to catch the sun's rays and direct them into three exhibits of solar phenomena

A visitor observing a portion of the sun through a spectrohelioscope which shows great jets of hydrogen shooting out from the red ball like huge fiery plumes

A SCIENTIFIC education at the touch of a push button! Like a gallery filled with robot lecturers, an amazing new museum at Los Angeles, Calif., is a wonderland of dramatized science. As the curious visitor pushes the 150 buttons that operate the sixty-four exhibits, experiments in physics, chemistry, geology, and astronomy work themselves as if by magic.

Entering the magnificent three-domed building that houses the $650,000 new Griffith Observatory is like visiting a big research laboratory. Switches click, motors hum, an arc crackles. High-voltage electricity buzzes in gas-filled tubes. The thumping of pistons, as vacuum pumps suck air from glass bulbs, mingles with the ghostly rapping of a mechanical hand as it taps on glass to align iron filings about the poles of a magnet.

Across the end of a dark cubicle, vivid colors play in weirdly shaped glass tubes mounted against a black-velvet wall. Ghastly green, lurid purple, beautiful shades of rose and lavender, ebb and flow as X rays and cathode rays stream from metal targets.

In the central rotunda, a giant Foucault pendulum swings eternally. Its 240-pound burnished-brass ball, suspended by steel wire, moves back and forth across a ruled dial, its majestic movement illustrating the principle that a weight once placed in motion, continues to move in the same plane, while the earth turns beneath it.

Stepping up to a plate-glass window, the visitor finds himself suddenly transported by rocket to within 500 miles of the moon. Glistening white under the reflected radiance of an invisible electric sun, looms the giant sphere of our satellite. It is a huge model, painstakingly built to an accurate scale of forty-three miles to the inch, from measurements on actual photographs made with the 100-inch telescope at the Mount Wilson Observatory.

Suddenly the orb appears to turn. Actually, it is the electric "sun" that is moving, propelled by hidden motors which cause it to pass overhead in a semicircular arc.

As the sunset line sweeps across the sphere, the "full moon" begins to shrink to its third quarter. In the accurately modeled

Mysteries of Earth and Heavens Unfold Themselves as Visitors Operate Ingenious Machines That Perform Interesting Experiments

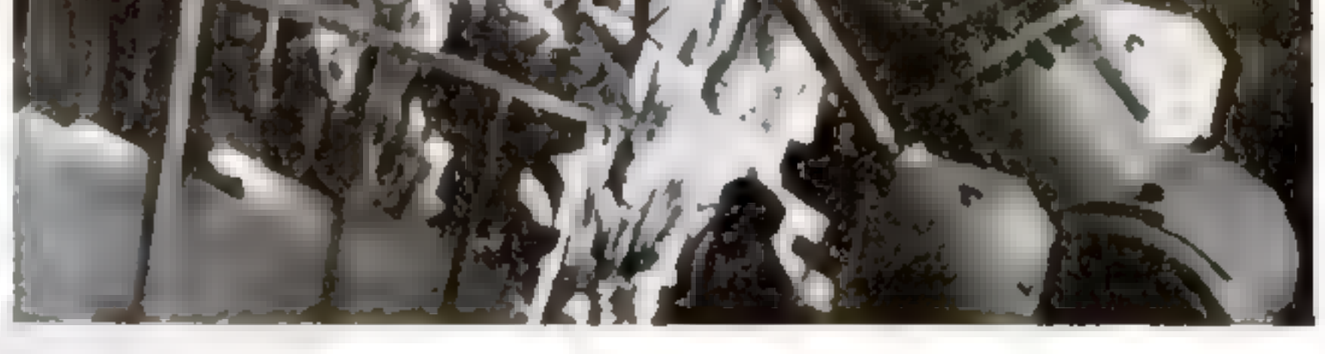
The surface of the moon is only 500 miles away as viewed in this realistic model made to scale from photographs

craters, inky shadows shorten, disappear, then grow again under the opposite rim of each pitted depression, projected by the six-mile-high peaks of lunar mountain ranges. Finally, in its last quarter, the moon dims to a thin crescent, and the "month" comes to an end.

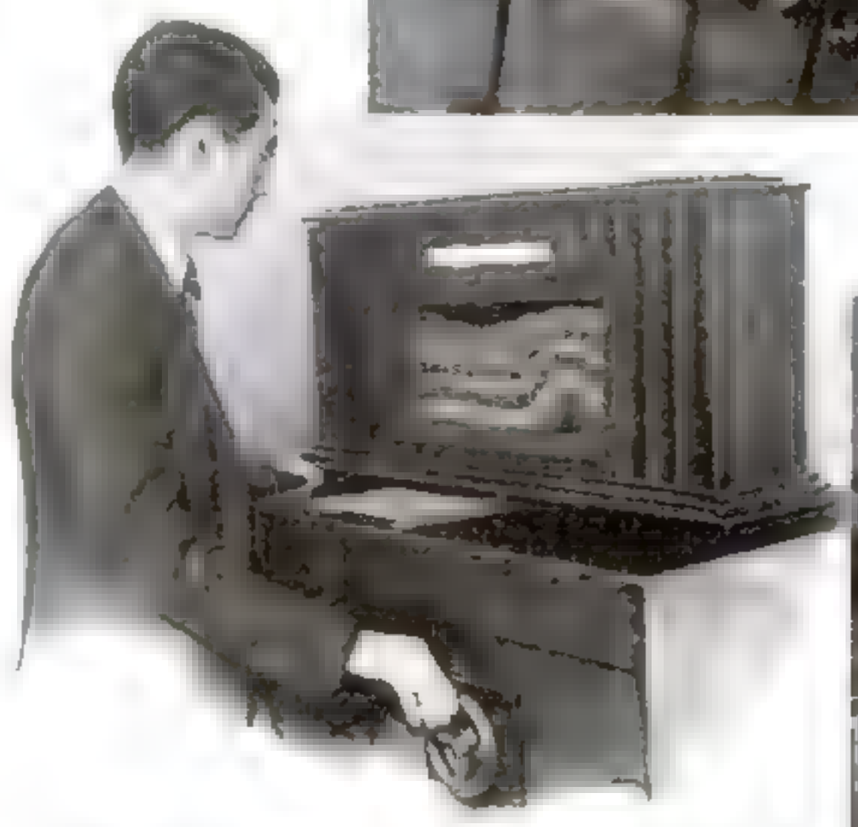
Another astronomical miracle awaits the observer who seeks to explore the heavens. Touching a button sets in motion a mechanism that projects a vivid white sun upon a ground-glass screen. An eclipse is about to be reproduced

As the moon creeps across the sun's disk, partial, total, and annular eclipses successively occur. A flaming corona forms, encircling the eclipsed sun. Just as the celestial body completely obscures the sun's disk, the jagged summits of lunar peaks are silhouetted sharply against the solar globe. Bright rays of the sun penetrate the valleys and glitter like diamonds, as "Baily's beads" stud the outer rim.

During the day, the sun itself is harnessed to provide thrills for the visitor. One of the observatory's three large domes forms the objective of a giant cœlostat. Atop a well of concrete encircled by an iron stairway, three circular mirrors catch the sun's rays and reflect them down forty feet to a second trio of reflectors, whence the three beams are deflected to different uses.



A lecturer explaining the mysteries of the observatory telescope to a crowd of visitors, who will be allowed to look into the eyepiece



Layers of sponge rubber, representing strata of the earth, upheave and fold as a crank is turned

A Foucault pendulum swinging from the ceiling makes the rotation of the earth actually visible by maintaining its own original plane of motion

One projects a clear, round image upon a ground-glass screen, upon which sun spots are seen to grow and wane as cyclonic storms rage upon our own star's seething surface.

A second beam passes through a spectroscope, whose brass eyepiece affords a view of the myriad bars representing the chemical elements of which the sun is composed.

The third beam passes through lenses and finally focuses upon a swiftly rotating prism, causing first one part, then another, of the sun's surface to be brought to view. So rapidly does this happen, however, that the result is a clear moving picture of a quarter of the sun's disk. Great jets of glowing hydrogen may be seen shooting out from the red ball, towering plumelike, miles into the solar "atmosphere."

A further introduction to the marvels of the heavens is offered those who attend the daily lectures in the planetarium. Here, to the accompaniment of soft music, visitors are wafted through interstellar space, as more than 9,000 stars and planets rapidly dramatize the astronomical laws of the universe at the bidding of the lecturer. More than 150,000 people have attended these demonstrations, and 12,000 school children have seen them as part of their school work.

Mysteries of mathematics reveal themselves in other fascinating exhibits. At the turn of a wheel, a large nickel-plated block obligingly "explodes" into pieces, concretely translating geometrical formulas into shapes and solids. Models made by stretching rows of strings illustrate various plane figures. Dozens of tiny balls fall through a forest of steel pins and drop into pockets to demonstrate the laws of probability and chance. Then, as a button is touched, the instrument is altered. The balls fall now through a maze of lopsided pins, producing "errors" that show why statistics often lie.

The earth itself is literally taken apart as wheels, knobs, and push buttons probe geological mysteries. At the turn of a hand crank, strata upheave and fold, *(Continued on page 128)*

Britain's Giant

The knifelike bow of the *Queen Mary*, a surprising contrast with the bulbous bows of recent super-liners

A rotor for one of the four huge turbines being made ready. Workmen are fitting and testing the blades by hand

By THOMAS M. JOHNSON

WHY have thousands of grown-up, sophisticated New Yorkers been crowding to gaze, fascinated, at a toy ship?

To be sure, it is the biggest toy ship the world ever saw: twenty-two feet long, three tons in weight, product of the skilled hands of twenty-five expert craftsmen who took three months to work out all its infinite details; it has 1,600 portholes, 214 windows, thousands of stanchions and rails. But this popular exhibit at the New York offices of the Cunard White Star Line is more than an amazing achievement in ship-model making. It is the forerunner of the greatest sea monster man has ever made.

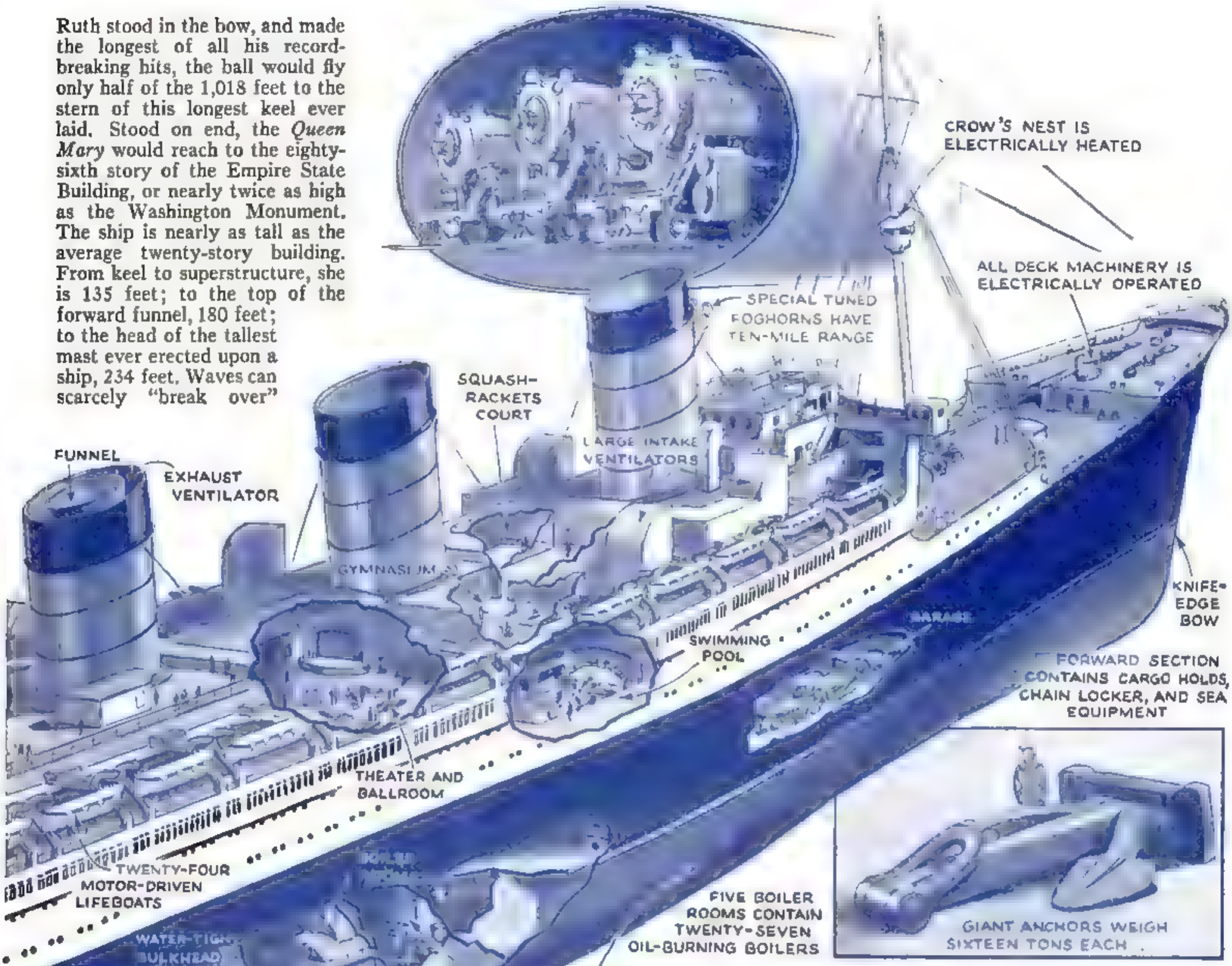
This spring, probably about June 1, there will sweep triumphantly into New York Harbor the vastest ship that ever sailed the seven seas; the Cunard White Star liner *Queen Mary*. She is the super-superliner, the last of that astounding procession of great ships—German, Italian, Polish, and French—that, one after another, have challenged credulity. But with the British *Queen Mary*, the race ends in a blaze of glory for maritime science and invention. They have built a new bridge across 3,000 miles of ocean, connecting the Old World and the New.

Superlatives? This monster man-made leviathan is full of them. Why, if Babe

Drawings by B. G. SEIELSTAD

Superliner *MARKS NEW TRIUMPH OF MARINE ENGINEERING*

Ruth stood in the bow, and made the longest of all his record-breaking hits, the ball would fly only half of the 1,018 feet to the stern of this longest keel ever laid. Stood on end, the *Queen Mary* would reach to the eighty-sixth story of the Empire State Building, or nearly twice as high as the Washington Monument. The ship is nearly as tall as the average twenty-story building. From keel to superstructure, she is 135 feet; to the top of the forward funnel, 180 feet; to the head of the tallest mast ever erected upon a ship, 234 feet. Waves can scarcely "break over"



such a floating Gibraltar, if the former Cunard commodore and *Titanic* rescuer, Sir Arthur Rostron, was correct in saying that no Atlantic waves higher than ninety feet had ever been measured.

Britannia will indeed rule the waves, with a vessel massive with materials that it took 250,000 men to provide, and then to weld into that mighty fabric which will bear 3,500 passengers and crew. Nor is she just another and bigger *Normandie*. The great new Britisher bristles with new appliances to make her not simply faster and bigger, but more efficient, safer, and more comfortable, than all her predecessors, amazing as each of them in turn has been.

How? Join the thousands of eager New Yorkers gazing at that unprecedented, gigantic toy. Look beneath the surface of its amazing completeness and accuracy, and what do you see? Here is something new in the designing of fast ships: The *Queen Mary* is neither squat nor rakish, and—amazingly, in these days—she is not streamline. Her bow is not a "modernistic" blunt-nosed affair to burrow into the waves, but knifelike. However, from there on rearward or aft, you see the subtle design of the last word in superships.

The bow is sharp, but it is also strong, and rather broad. Then, just as the well deck begins, the ship narrows down and starts over again. She thins out, as if she were a smaller vessel crammed into the bow of a larger one. The result is that the bow makes a path for the rest of the ship by breaking the seas. In the same manner, the wind and spray are tricked, given little or nothing at which to snatch with delaying fingers; few cluttering small deck houses, ventilators, winches, and life rafts. The *Queen Mary* probably has more clear, unobstructed deck space than any ship afloat; it totals twenty acres, and a football game could be played on the after end alone.

Seafaring England expects these new ideas in shipbuilding to produce a ship that can cross the Atlantic faster than ever a ship crossed it before, and make a new record between Southampton and New York. They believe the *Queen Mary* will do it not only in less than four days, but will outspeed the present record holder, the French liner *Normandie*. That is the cherished hope of the British, although they do not say so; in fact, they point out that the *Queen Mary* was planned and laid

down before the more rapidly built French vessel, and will not conflict or compete with it directly.

But, they believe, the *Queen Mary* will be faster and yet more comfortable than any of its predecessors among superliners. It is no secret that, with some of them, speed has meant vibration so great as to be distinctly noticeable. But the British think they have met this apparent threat to further reduction in the time needed to cross the Atlantic, which made it seem that if liners were made much faster, they would jar their passengers to pieces.

There must be new ideas to stop vibration. Presumably, it depends upon propeller weight in relation to horsepower, and the weight and balance of the hull. The *Queen Mary's* four propellers weigh thirty-five tons each, and spread, from tip to tip, nearly twenty feet. They are the largest ever cast for any ship, eight tons heavier than those of the *Normandie*. The great new Britisher herself will probably displace 4,000 tons more of water than the Frenchman, for her eventual displacement will probably be 83,000 tons. She will have 40,000 more horsepower. This combination of weight and power is expected to free her from the bogey of superliners, vibration.

BUT, as additional protection, the ship designers have adapted to this superliner of the seas the newest wrinkles of those superliners of the air, the transport planes, and even of automobiles. The *Queen Mary's* engines are "cushioned" in their housings. Instead of being riveted directly to the bed plating, as in earlier steamship construction, the foundations in the engine room are "sprung."

The engines themselves are the most powerful combination ever created and harnessed for any mechanically propelled vehicle. They will develop 200,000 horsepower—50,000 for each shaft—a record for ocean liners or anything else. They are single-reduction-geared turbines, containing 257,000 blades, each one fitted by hand. The turbines are in four sets, connected through gearing to shafts carrying four giant propellers. Steam is supplied by twenty-four oil-burning water boilers of the Yarrow type, at 440 pounds pressure, and a temperature of 700 degrees Fahrenheit. Three additional boilers supply steam for the turbo-electric generator equipment.

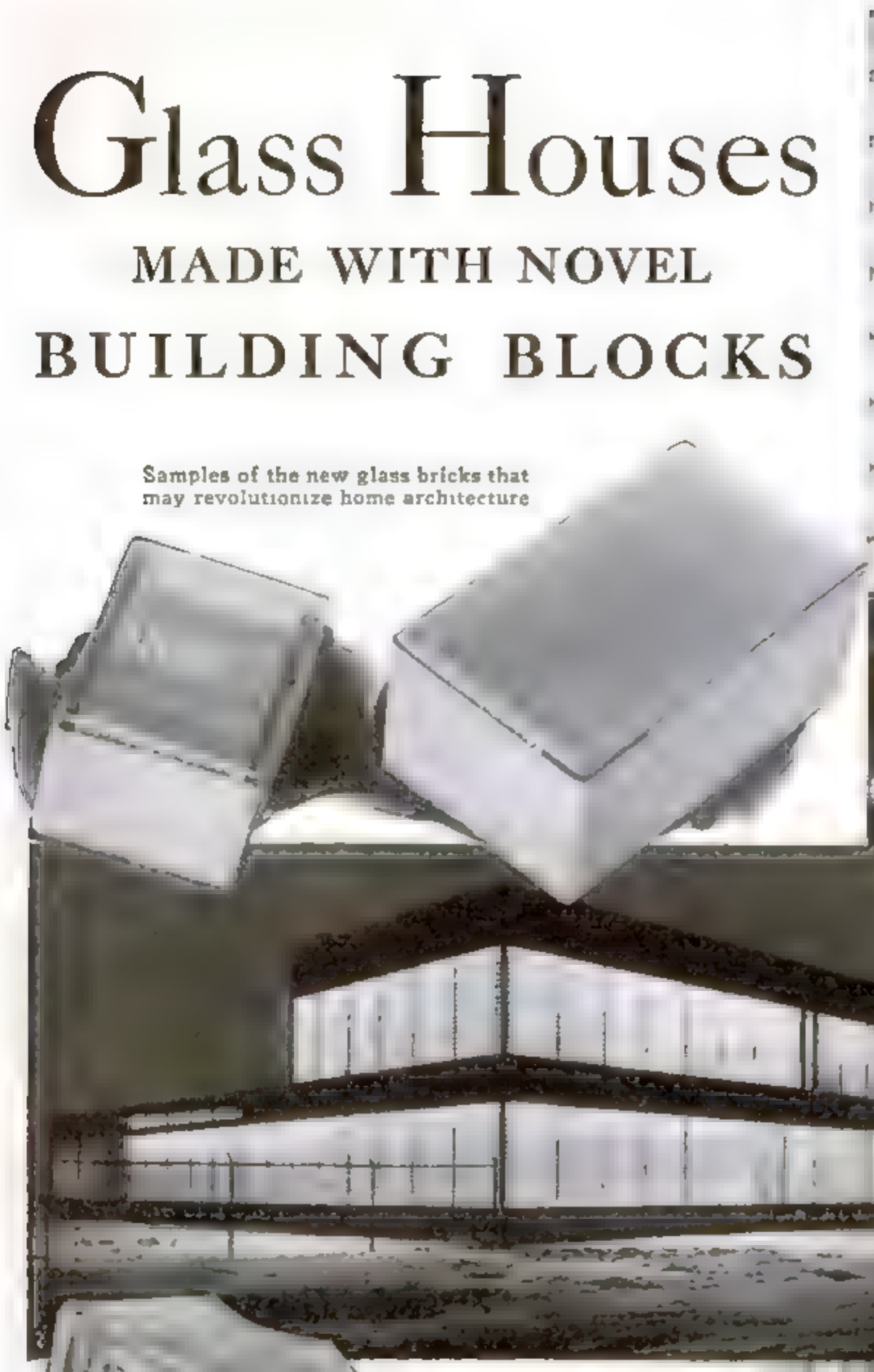
By these new and superlative means, it is hoped the new man-made leviathan will be able to make even her highest speed without objectionable vibration. What this highest speed will be, can be told in April, when the *Queen Mary* will have her eighteen days' trials out of Southampton. To get there, she must go down the River Clyde on the spring tide on March 24. In the meantime, the sum of $100,000 must be spent to dredge Southampton harbor so the monster vessel can maneuver. *(Continued on page 130)*

The new queen of the sea in the fitting-out basin at Clydebank, Scotland. Her 145-ton steel anchor chains are seen at the right

The last of the *Queen Mary's* three enormous funnels being installed. The drawing at the left gives a comparison of her size with that of the *Britannia*, the first Cunarder, and of the flagship of Columbus

Glass Houses

MADE WITH NOVEL BUILDING BLOCKS



Samples of the new glass bricks that may revolutionize home architecture

The background of this scene is not a window, but a wall of the new material

The world's first windowless, all-glass building, a research laboratory in Toledo, Ohio. The walls are translucent but are not transparent. Left, a corner block

Workmen building a wall of glass brick. The blocks are reenforced by steel members at short intervals

People can now live in glass houses—and even throw stones, without fear of serious consequences. A new method of building that makes this possible was revealed not long ago in Toledo, Ohio, by the completion of an all-glass, windowless, two-story, thirty-nine-room building which houses a research laboratory. Building experts believe that this unusual structure may be the forerunner of thousands of glass buildings of all kinds—homes, schools, factories, and other structures in which light, strength, and low upkeep cost are desirable.

The all-glass laboratory makes use of recently perfected glass building bricks which diffuse daylight horizontally and evenly into a room. Translucent rather than transparent, the hollow bricks contain a partial vacuum which acts as an insulator against heat and cold. Experts point out that a glass-brick wall costs less than a complete wall of ordinary brick, and is much stronger; recent tests at Purdue University indicate that a single layer of these blocks would support the 555-foot granite shaft of the Washington Monument.

Architects, speculating on the future, envision a glass dwelling that will have no windows around which cold, dust, and dirt can seep in. People will look outdoors through immovable panels of plate glass set into the walls. Air-conditioning apparatus will supply fresh air, warm or cold according to the season; it will also maintain a slight air pressure inside the house so that air will rush out instead of in when an outside door is opened, thus preventing the entrance of dust and dirt. Insulating glass walls will save heating costs and will be easy to clean with a damp cloth.

Ceilings will be made of sound-absorbing spun glass supported by wire mesh. Plumbing and gas pipes, and electric cables, will be concealed in the reënforcing frames in the walls. Telephone, doorbell, and radio wires will be hidden in the glass-brick mortar joints. Daylight flooding through the walls will eliminate dark, dingy corners and hallways, and specially mounted curtains and blinds will be drawn to shut out sun glare or darken a room.

ONE-WAY LIGHT

By ROBERT E. MARTIN

These disks of the new polarized material are as clear as ordinary glass, but when "crossed"—placed with their optical axes at right angles—they extinguish light, forming a black spot where they overlap

Edwin H. Land shows how his discovery ends headlight glare. Both lamps are fitted with light-polarizing screens; the inventor is masking one with a second screen which represents the windshield of the other auto

At left, polarized light produced by reflection from glass or water
Right, same effect secured by passing light through polarizing screen

A polarizing material acts as a valve for polarized light, transmitting it in position (1) and shutting it off when "crossed" as at (2)

NEW marvels worked with light amazed witnesses of a recent demonstration in New York City. They tried out magic spectacles through which a fisherman can spot fish swimming under water, and viewed automobile headlights from which the glare had been mysteriously removed. Three-dimensional movies in full color were displayed in the first practical form for theater screens. A working model demonstrated apartment-house windows that allow people to see out, but not in.

These are a few of more than 800 commercial applications foreseen for a new optical material, resembling plain, transparent glass, that has the power of producing and controlling polarized light.

Everyone has seen polarized or "one-way" light, though not all may know it by name. It looks exactly like ordinary sunlight or lamplight. Much of the light reflected from water, from polished objects, and from the sky is polarized—that is, the helter-skelter waves of ordinary light have been strained out, leaving only those that are vibrating in a single flat plane. Some of the peculiarities of polarized light are shown in the accompanying diagrams. For example, it may be produced artificially by passing ordinary light through a crystal of Iceland spar or of tourmaline. A crystal of the same kind will serve as an optical valve to control light that has already been polarized—transmitting or extinguishing it according to the angle to which the crystal is turned.

Practical applications of these curious phenomena have been restricted to the laboratory, however, by the scarcity and prohibitive cost of such natural crystals in all but the most limited sizes. Now, for the first time, an inexpensive synthetic substitute is available for popular use, in an almost unlimited variety of shapes and sizes. Polaroid, as the new glasslike material has been named, may be fashioned into eyeglasses, windows, headlamp lenses and windshields. Screens made from it, like crystals of Iceland spar and tourmaline, will turn ordinary light into polarized light, or act as a valve for light that is already polarized. Depending upon which of these two purposes they serve, the screens are known respectively as "polarizers" or "analyzers," and may be used singly or in combination to produce a multitude of striking effects.

Spectacles with lenses made of this remarkable substance extinguish the glare upon the surface of water, enabling a fisherman to peer beneath and see where his quarry lies. The glare consists mainly of polarized light, and the lenses are permanently fixed at the proper angle to serve as "analyzers" and shut it off. The spectacles may also be used as sun glasses, shielding the eyes from the dazzling brilliancy of sea, sky, or snow.

How the new material will aid photographers. The picture at left, below, was made under ordinary conditions, the one at the right with the new lens screen. Note how the excessive brightness of the sky was subdued

Works Optical Wonders

Lens screens for cameras, just introduced by the Eastman Kodak Company, employ the new product in similar fashion to destroy troublesome reflections in photographic compositions. The screens will also subdue sky brilliancy to suit the photographer's taste—offering the only known means of doing this in color photography, where tinted filters for the purpose would be taboo.

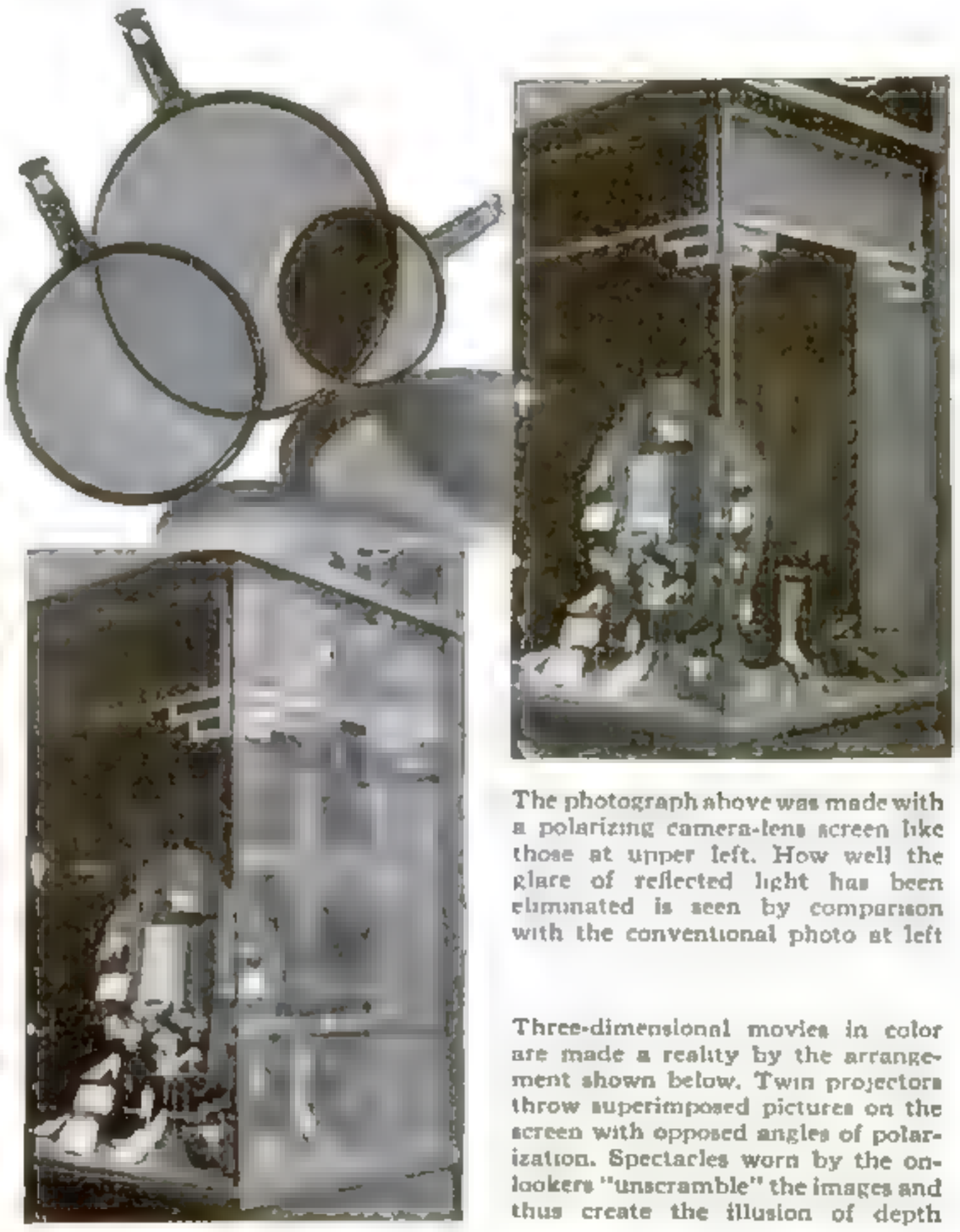
To provide privacy for apartment dwellers, windows facing a court could be glazed with the glasslike substance. Opposite panes would be "crossed," or set with the optical axis of each at right angles to that of the other. Tenants could then see out of their own windows, but not into the ones across the court, which would appear dark. The far window would polarize all light coming from it, and the near window would act as an "analyzer" to shut this light off.

If all cars employed headlamp lenses and screens of the light-polarizing "glass," the inventor maintains, the menace of glaring headlights would be conquered, and driving by night would become as safe as by day. Every car would be identically equipped, with the optical axis of each pane set at a slant of forty-five degrees. When cars met head-on, the headlamp screen of one and the windshield screen of the other would thus be "crossed" at an angle of ninety degrees, and even the most dazzling headlights would be subdued. Because of the nearly complete extinction of their polarized beams, they would appear only as dim, purplish beads of light. A driver's view of the road, on the other hand, would be unaffected, since the reflected illumination of his own lights would be polarized at the right angle to return through his windshield. Since glare would be eliminated, headlamp bulbs of unlimited power could be used, and would add new scenic beauties to night driving.

Color movies in three dimensions, produced with projecting and viewing screens of similar composition, were shown at the New York demonstration. Pictures from twin projectors are superimposed on a single theater screen, by beams of light polarized in opposite directions. Viewing spectacles with corresponding "analyzing" lenses unscramble the pictures, so that each eye sees only the view intended for it. The combination of color and depth gives the movies startling realism.

The new optical material that permits these feats is the invention of a twenty-five-year-old Boston experimenter, Edwin H. Land. It consists of a transparent film of cellulose composition, sandwiched between cover glasses, which has been impregnated with billions of tiny rodlike crystals of an organic iodine compound, so small that they are invisible under a microscope magnifying more than 1,000 times. Their parallel arrangement, however, gives them the polarizing effect of a single large crystal. Arrangements have been announced to manufacture the synthetic material in quantity, to provide an adequate supply for its many predicted uses.

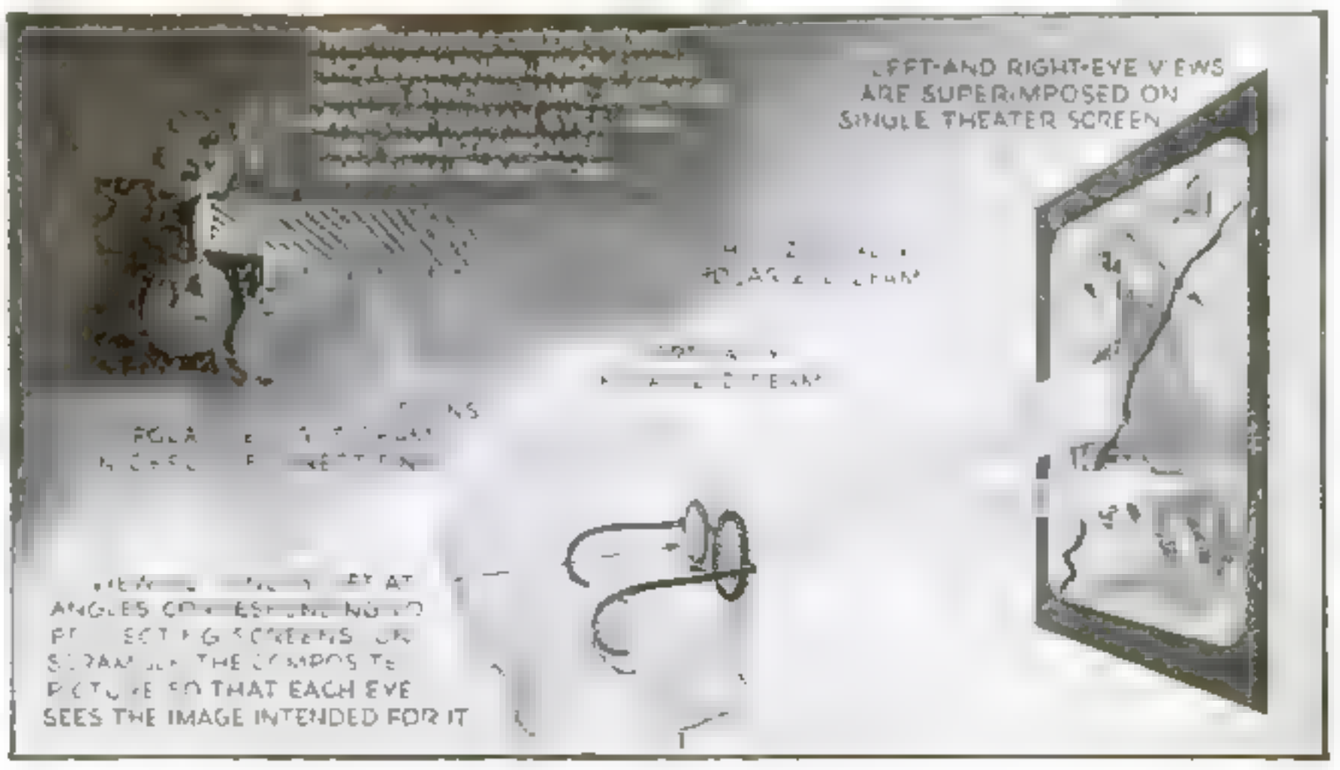
"Magic spectacles" for fishermen make it possible to see fish as they swim under water. Screens in the lenses are permanently fixed to filter out the polarized light that is reflected from water, thus eliminating the glare that ordinarily impairs visibility. Note how they blot out the surface shine



The photograph above was made with a polarizing camera-lens screen like those at upper left. How well the glare of reflected light has been eliminated is seen by comparison with the conventional photo at left

Three-dimensional movies in color are made a reality by the arrangement shown below. Twin projectors throw superimposed pictures on the screen with opposed angles of polarization. Spectacles worn by the onlookers "unscramble" the images and thus create the illusion of depth

A model to demonstrate one-way windows for apartment-house courts. Occupants of an apartment could see out of their own windows, but not into those across the way; the latter would appear opaque. Pencils indicate optical angles



TOW LINE PULLS SKIERS UP HILLS

SKIERS now use ingenious tow lines, equipped with special handles, to save tiring and time-consuming climbs up steep slopes. At St. Moritz, Switzerland, where the installation shown in the accompanying photographs has been made, the skier grasps a long tubular handle suspended from a constantly moving endless cable, leans backward against the curved end of the handle, and is hauled 800 feet up the incline. In case of an emergency, the skier releases the handle and a spring mechanism jerks it forward and upward, safely out of the way.

A tow line installed at St. Moritz, Switzerland, to give skiers a lift to the top of a slope. The user grasps a long, tubular handle and leans back on its curved end, as in inset

Portable radio transmitter in use. Note the antenna rods

At left, the set's three-inch cabinet

POCKET RADIO TRANSMITTER AIDS NEWS BROADCASTS

A POCKET radio transmitter, using less power than a common flash light, now enables broadcast announcers to dispense with heavy equipment in eyewitness reporting of news events. Using a wave length of only one meter, the miniature set carries the announcer's words to a pick-up station situated anywhere within a four-mile radius, for retransmission to the broadcasting station. A three-inch cube houses the transmitter.

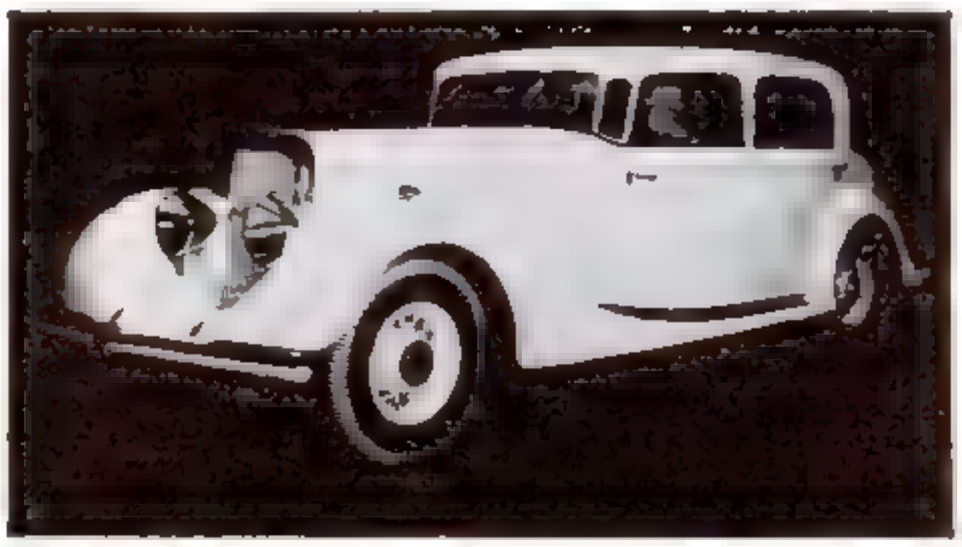
BELGIANS PUT CART BEFORE THE DOG

A Belgian business man going to work in his dog-powered cart

LIKE a cart before a horse, a three-wheeled vehicle of a type popular in Belgium, and nicknamed the "poor man's taxi," is propelled by a husky dog plodding between shafts at the rear. The solitary rider sits within an equipage resembling a motorcycle sidecar and steers with handlebars, enjoying comfortable if not speedy transportation.

GLOWWORM CAR SHINES IN THE DARK

COATED with luminous paint, a car exhibited by a leading French manufacturer shines in the dark with weird green light. Practical use of the odd idea has been proposed as a means of increasing the visibility of cars upon the road at night and thus reducing the danger of collisions.



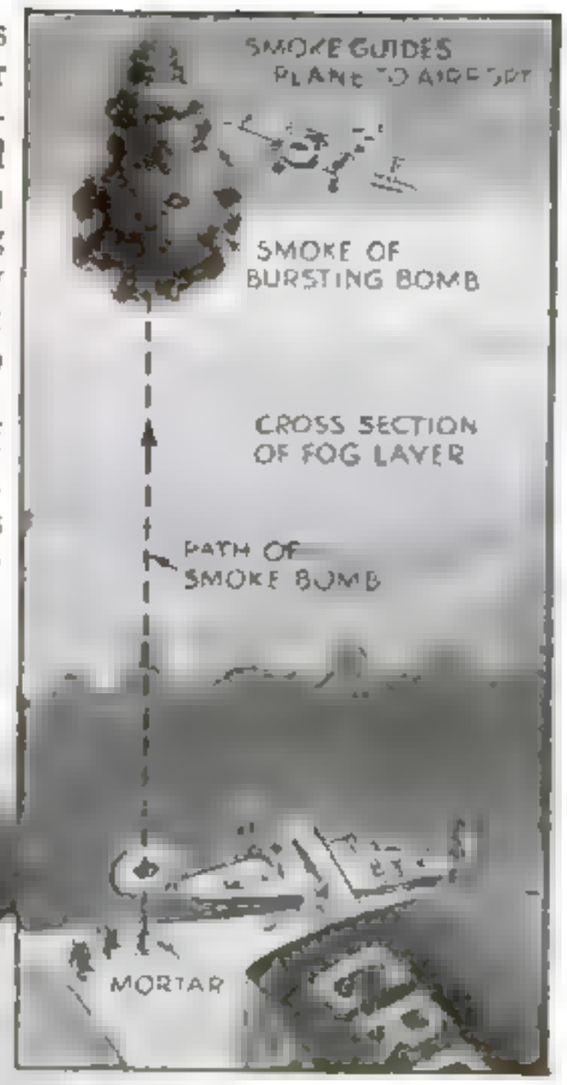
Luminous French automobile as photographed by its own light

ONION AND GARLIC ODORS KILL TUBERCULOSIS GERMS

FUMES from freshly ground onions or garlic may prove valuable in the treatment of tuberculosis. In recent experiments conducted by Dr. C. C. Lindegren of the University of Southern California, germs which cause the disease were killed three times faster when exposed to strong garlic vapor than when submerged in boiling water. Dr. Lindegren is shown above comparing an untreated culture (left) with one he has treated.

SMOKE BOMBS GUIDE FLYERS

WHEN low-hanging fog banks hide Croyden Aerodrome, near London, England, airport officials use smoke bombs fired from a mortar to guide pilots in to a safe landing. Incoming planes signal their approach by radio, and a smoke shell is shot from the cannon 1,000 feet into the clear sky above the fog. Here it bursts, throwing off dense clouds of black smoke. Steering by this signal, pilots maneuver to the spot and dive their planes down through the fog layer to the landing field.



How smoke bombs, fired into clear air above fog, guide flyers down to an airport

At left, an airport employee firing the mortar which will hurl a bomb to act as a landmark for an incoming plane

Electric exerciser in use to simulate the motions of bicycle riding

NOVEL EXERCISING MACHINE DOES ALL THE WORK

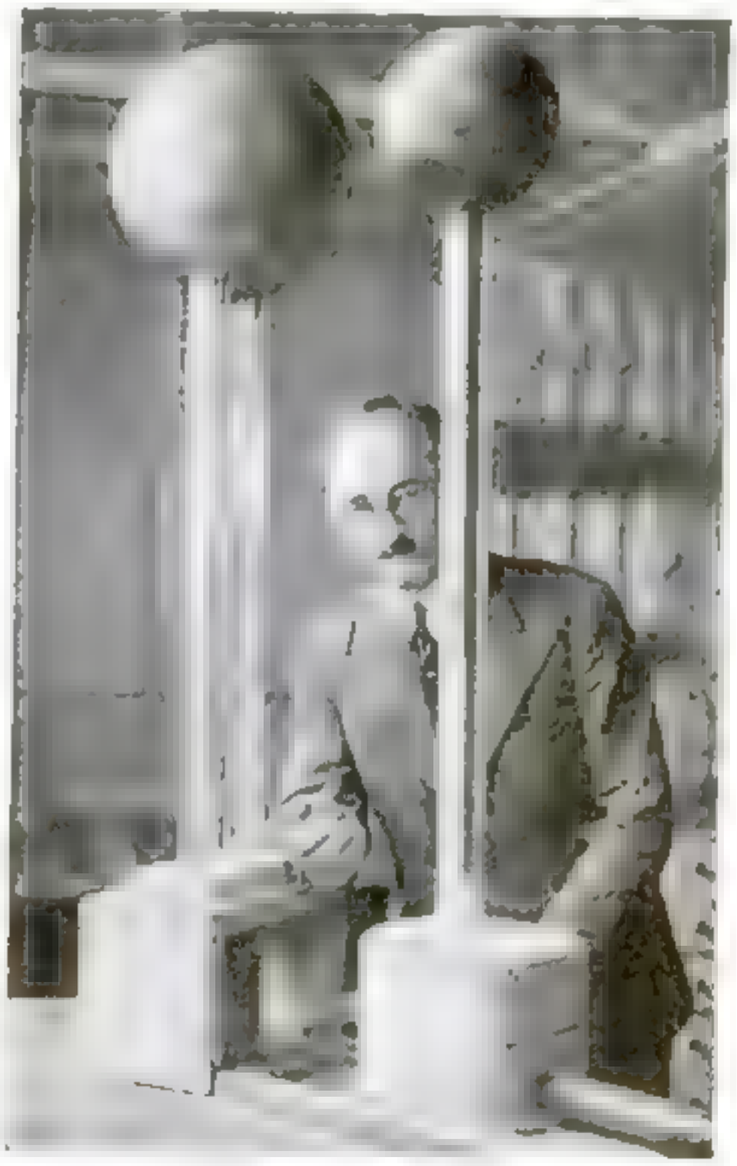
ELECTRICITY supplies the motive power for a machine that is said to do your exercising for you. When the user presses a button, an electric motor operates shafts and gears that simulate the motions of horseback riding, rowing, or cycling.

THERMOSTATIC FINGERS CATCH CIGARETTE BUTT

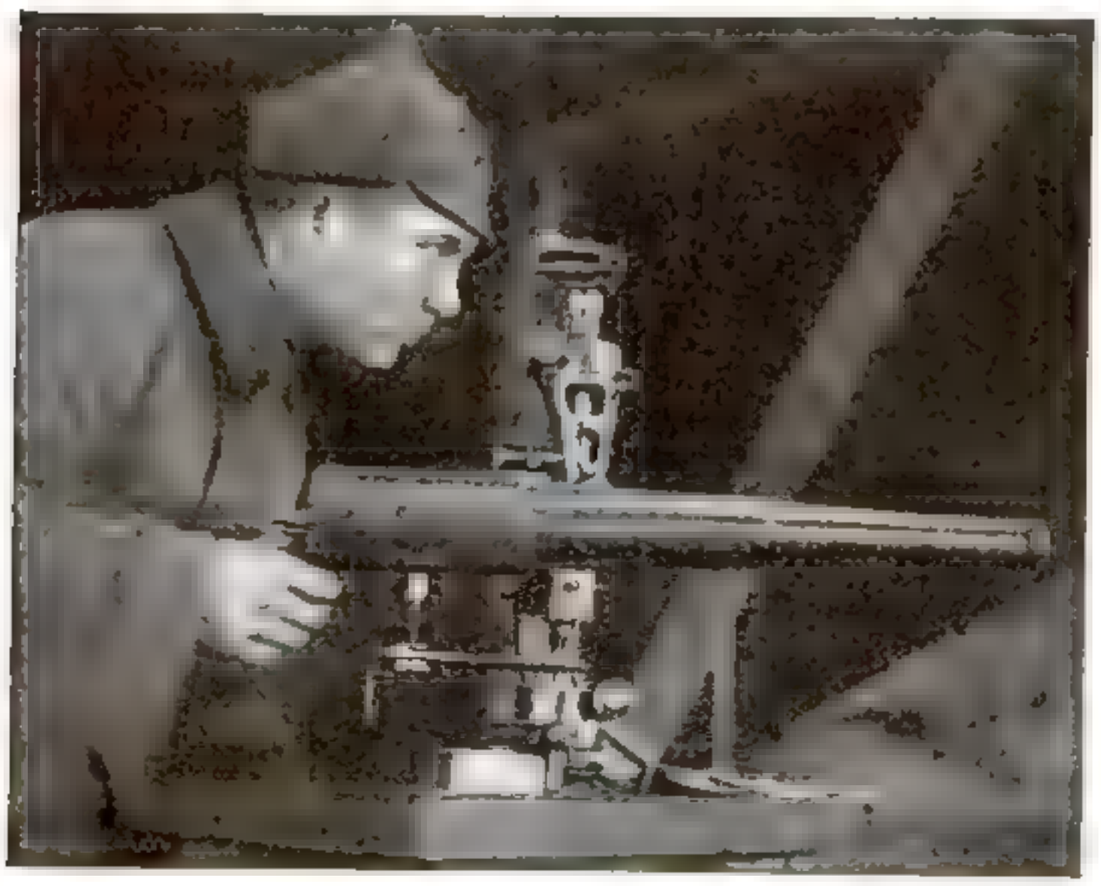
SO THAT a forgotten cigarette will not drop from its rest, a novel ash tray employs a guard acting on the principle of a thermostat. If the cigarette burns short, bimetallic fingers, actuated by its heat, automatically close upon it and hold it firmly until it goes out.

SPIKE FILE LOOKS LIKE TABLE LAMP

A NOVEL spike file resembling a table lamp has been devised to sort and hold phone messages for several persons. The odd device consists of a hexagonal pyramid which revolves on a pedestal; one spike juts upward from the bottom of each of the six sides.



MINIATURE CANNON TRAINS GUNNERS



A Russian gunner at target practice with a realistic miniature howitzer

A SMALL-CALIBER howitzer in a specially devised mounting has recently been developed by Russian military authorities for use in artillery target practice. The howitzer is equipped with sights and range-finding instruments which operate in the same manner as similar apparatus on full-sized field guns. Thus, gunners can acquire heavy-artillery training and experience with a practice gun requiring much smaller and less expensive ammunition.

'DUST STORM' GENERATOR YIELDS 500,000 VOLTS

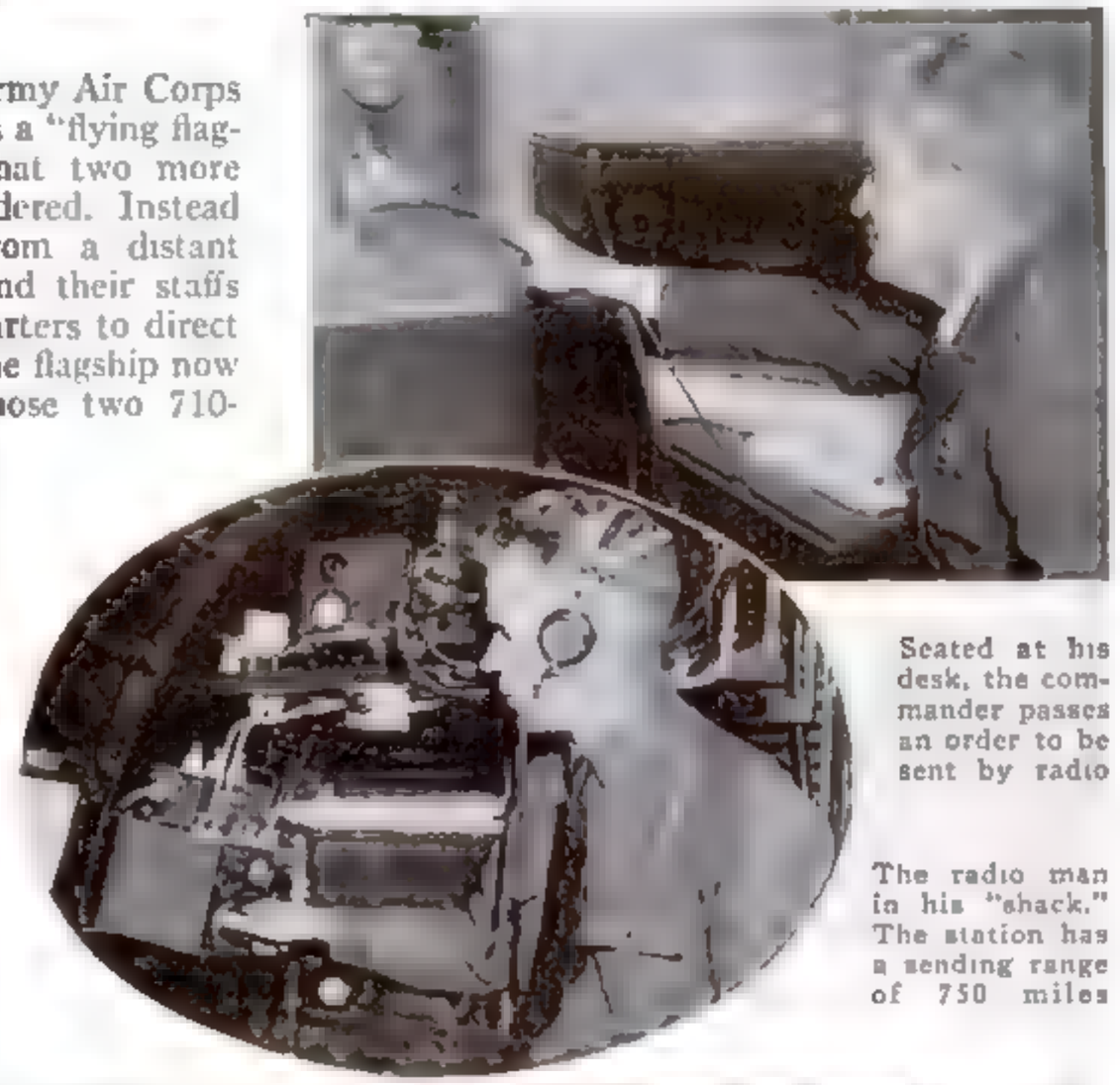
How dust storms charge metal objects with static electricity is shown by a high-voltage generator developed in France. A blower drives electrically charged dust up a hollow glass tube and into a twelve-inch metal sphere, where it gives up its charge. Leaving the sphere through a second tube, the dust repeats the circuit. Charges piled up on the sphere give it as high a potential as 500,000 volts.

FLYING FLAGSHIP HOUSES COMPLETE ARMY AIR CORPS HEADQUARTERS

Carrying full headquarters equipment, this plane is the Army air chief's flying base

Special parachutes are kept in racks near exit door of plane. The 'chutes can be attached quickly to the harness worn by each flyer

TESTS conducted by the U. S. Army Air Corps of the first plane ever designed as a "flying flagship" have proved so successful that two more craft of the same type have been ordered. Instead of conducting aerial maneuvers from a distant ground base, commanding officers and their staffs may now soar off in a flying headquarters to direct squadrons of planes from the air. The flagship now in use is a Douglas monoplane whose two 710-horsepower motors drive it at a top speed of 210 miles an hour; unarmed, the plane has a service ceiling of 23,200 feet—above the range of anti-aircraft artillery. Two radios are carried, one for distant communication, and one for issuing orders to accompanying planes. In addition to radio and control rooms, the plane has an office for the commander, another for his staff, a buffet room, baggage compartment, and lavatory. Near the exit door is a rack containing special parachutes which can be quickly attached to the 'chute harnesses worn by officers and crew.

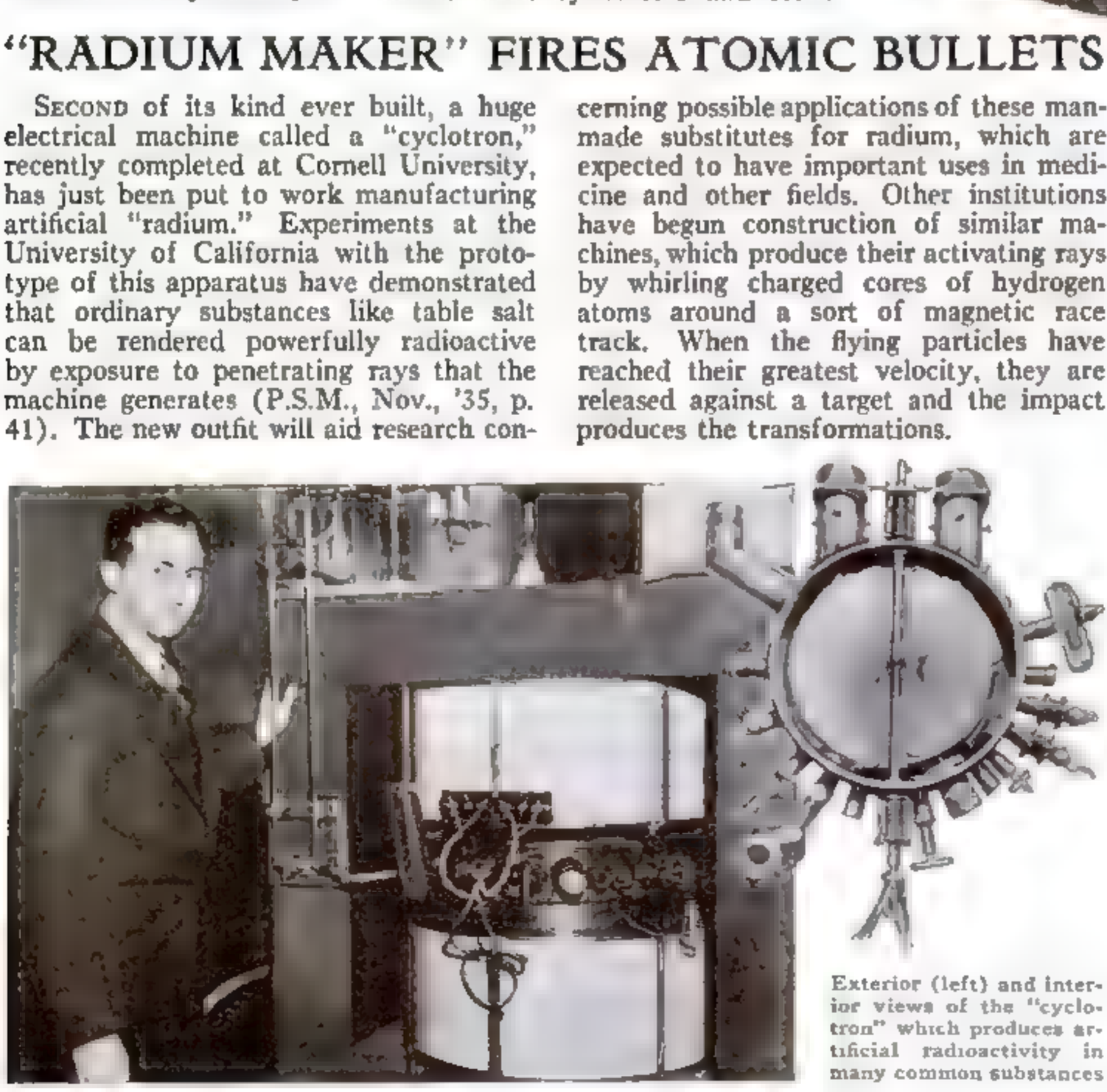


Seated at his desk, the commander passes an order to be sent by radio

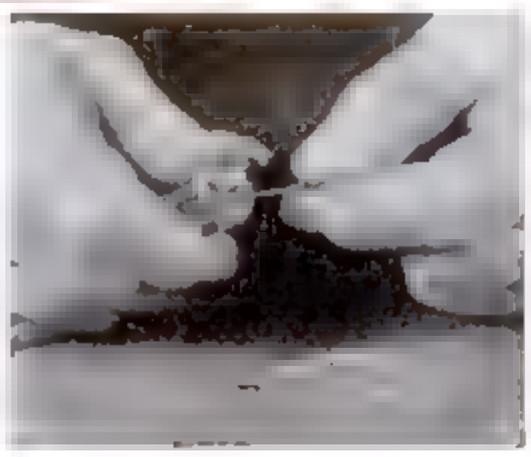
The radio man in his "shack." The station has a sending range of 750 miles

"RADIUM MAKER" FIRES ATOMIC BULLETS

SECOND of its kind ever built, a huge electrical machine called a "cyclotron," recently completed at Cornell University, has just been put to work manufacturing artificial "radium." Experiments at the University of California with the prototype of this apparatus have demonstrated that ordinary substances like table salt can be rendered powerfully radioactive by exposure to penetrating rays that the machine generates (P.S.M., Nov., '35, p. 41). The new outfit will aid research concerning possible applications of these man-made substitutes for radium, which are expected to have important uses in medicine and other fields. Other institutions have begun construction of similar machines, which produce their activating rays by whirling charged cores of hydrogen atoms around a sort of magnetic race track. When the flying particles have reached their greatest velocity, they are released against a target and the impact produces the transformations.



Exterior (left) and interior views of the "cyclotron" which produces artificial radioactivity in many common substances



Tying fastening loops in wire, like that holding the fish hook above, is easy with the tool shown at right

HANDY POCKET TOOL TWISTS LOOPS IN WIRE

WIRE loops may now be made perfectly without the use of pliers by means of a metal vest-pocket tool. Wire inserted between posts is held in place by a thumbscrew. A loop is formed by bending one end around a metal post. The loop is then transferred to the opposite end of the tool, a holding pin is inserted and, with this as a pivot, the tool is revolved to make the desired number of turns.

Diagram shows the steps in making a wire loop

Rubber Strands Launch Pedal-Driven Glider

Pilot ready to release anchoring prongs and launch his glider

ONE MAN can launch a glider from level ground by a new method devised by a German inventor. The pilot anchors the glider by forcing two wooden prongs down into the ground through holes in the fuselage. When these are released, the soaring plane is launched by the contraction of a long rubber cable stretched tightly from the ship's nose to a block fastened in the earth. One man working alone could not pull and fasten a cable large enough to provide sufficient motive power, so the inventor forms his cable of numerous separate rubber strands, and stretches each one singly. He has applied his launching scheme to a curious motorless machine described in a recent issue (P. S. M., Jan. '36, p. 36), in which a propeller may be operated by foot pedals in order to prolong a flight or assist in guiding the craft toward favorable air currents which will enable the pilot to continue soaring and frequently eliminate the necessity of a forced landing.

The inventor stretching the individual rubber bands which hurl his sailplane into the air

SCREW DRIVER HAS FLEXIBLE SHAFT

A NOVEL screw driver recently placed on the market has a flexible shaft so that the tool can be used in awkward places where a screw is difficult to reach. The user holds the blade tip in the screw head by gripping a loose collar on the lower end of the shaft, which resembles a speedometer cable.

This novel camera mounting allows movie shots to be made from any angle

STUDENTS BUILD P.S.M. SEISMOGRAPH

California high-school students with the seismograph they made for use in physics classes

FOLLOWING plans published in the November, 1935, issue of POPULAR SCIENCE MONTHLY, four physics students of Phineas Banning High School, Wilmington, Calif., constructed a school seismograph on which earthquakes 5,000 miles away have been accurately recorded and plotted. The total cost of building and setting up the instrument was about six dollars. Record sheets are changed weekly and an average of one 'quake a week has been registered.

NEW MOVIE-CAMERA MOUNT SAVES TIME

A COMBINATION camera mounting that will save two hours a day in "shooting" time has just been perfected by engineers of a Hollywood, Calif., movie studio. The 750-pound machine combines a movable rubber-tired dolly, an adjustable tripod on a universal joint, and a six-foot crane that can swing around in a complete circle. Cameramen can now shoot pictures from practically any angle with little loss of time in adjusting the camera.

MAGNETIC PIPE DETECTOR TRACES HIDDEN LINES

FORGOTTEN routes of metal pipe lines laid years ago are easily traced with a magnetic pipe detector recently perfected by General Electric engineers. The instrument consists of a surveying compass, an adjustable bar magnet, and two sensitive radial fins which act as magnetic antennas. When moved about in the vicinity of the pipe line, the device accurately detects the pipe's exact location and depth.

"VACUUM PACKING" KEEPS MILK FRESH

MILK remains sweet and fresh for more than three months when treated by a new vacuum process developed by a Chicago inventor. Uncovered bottles of pasteurized milk are carried on a moving belt to a capping machine, the chamber of which is filled with dry steam. Here the surface of the milk is sterilized and the bottles are vacuum-sealed with air-tight metal caps. Although the vacuum-packed milk cannot be exposed like other canned and bottled foods and must be kept in a refrigerator, tests have shown that the milk remains in perfect condition for months. It is claimed the process will revolutionize methods of distribution and cause the repeal of laws requiring milk to be sold within thirty-six hours after bottling.

Inventor explains how milk is sterilized in new bottle-capping machine

FLICKERING SUN MAKES WEATHER

WEATHER variations are caused by "flickerings" of the sun, according to Dr. Charles G. Abbot. If the sun's warmth remained constant, he says, the earth would have climate but no weather.

RADIO WAVES MAKE GLASS SING

BEFORE a group of skeptical onlookers, Harry Blackstone, world-famous magician, recently touched his "magic" wand to a glass and made it sing. The sounds were part of a radio program broadcast by the powerful transmitter of station WLW, located near-by, and were caused by a tiny electric arc leaping between the metal wand and the liquid in the glass, vibrating the air with the modulations of the radio program.

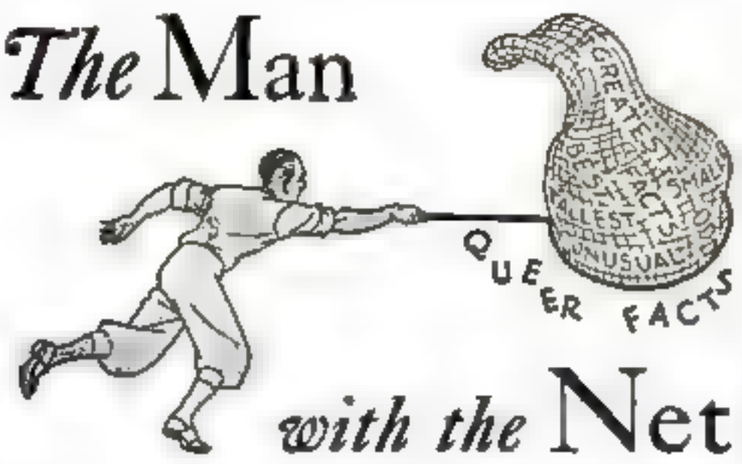
Harry Blackstone, magician, drawing radio music from water

French test shows how sand, used on left side, checks the action of incendiary bombs

SEES FIRE BOMBS AS AIR-RAID PERIL

THOUSANDS of fire bombs showered on cities by enemy bombers will prove a far greater war-time menace than poison gas, according to Professor J. E. Zanetti of Columbia University. Gas soon spreads and dissipates itself in air, Professor Zanetti explains, but one two-ton plane, eluding a city's aerial defenses, could scatter 2,000 of these two-pound incendiary bombs and start hundreds of fires raging in all parts of the city. The lightweight bombs contain thermite, a mixture of metals that changes chemically into an incandescent molten mass at the moment of impact. Realizing the danger, French authorities plan to cover exposed areas with layers of sand. In recent tests, sanded roofs absorbed and cooled the white-hot substance before it could start a fire. In the experiment pictured above, the sanded cover of the dummy hangar on the left resisted four bombs, while the other was destroyed.

The Man *with the* Net



SIX SPECIES *provide from seventy to eighty percent of all fish caught in the United States.*

TWELVE LETTERS *form the complete Hawaiian alphabet.*

PARASOLS *were the symbols of rank and authority for many centuries in the Far East.*

DEPARTMENT OF JUSTICE *agents have compiled a "moniker" list, containing 80,000 aliases used by criminals.*

REINDEER, *like salmon, return to the place of their birth to bear their young.*

ABOUT EIGHT INCHES *a day is the distance covered by the tip of the hour hand on an average watch.*

WORLD PRODUCTION *of silk thread is about 48,000 tons a year.*

MOOSE PEAK LIGHTHOUSE, *at the mouth of the Bay of Fundy, is located at the foggiest spot in the United States.*

ALUMINUM *and gold, both malleable metals, combine to form an alloy that is nonmalleable.*

CHOW MEIN *is a balanced meal in itself.*

SIXTY PERCENT *of the surgical instruments made in America are manufactured in Philadelphia, Pa.*

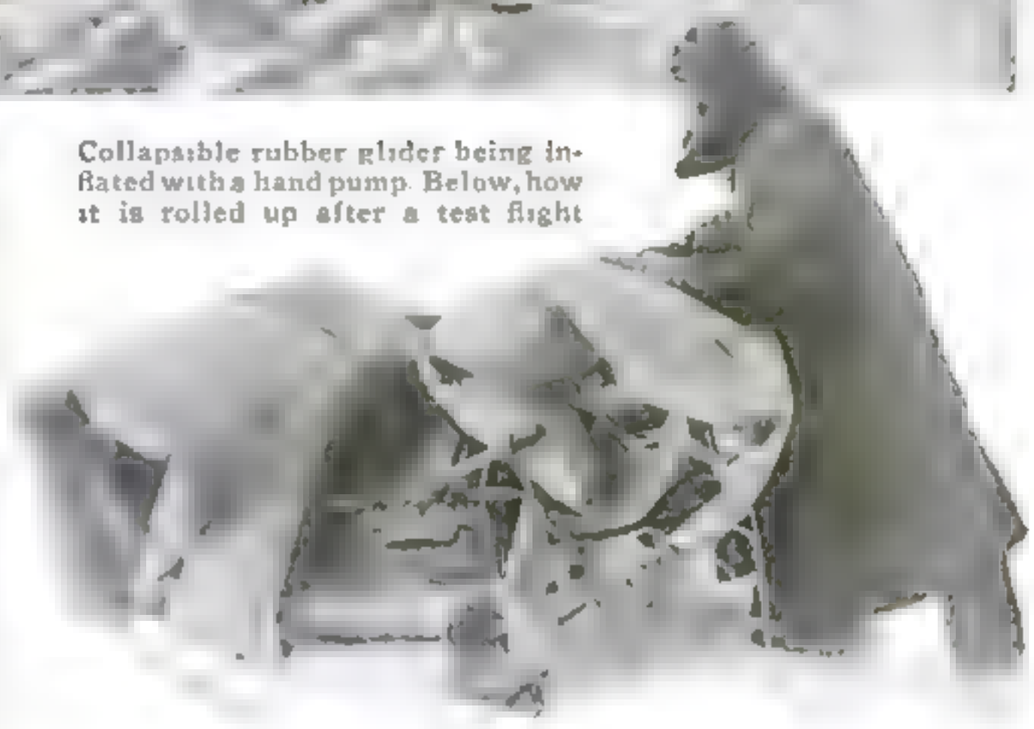
MACHINE-GUN BULLETS *were used recently to puncture a tank car of burning gasoline and prevent an explosion.*

SEALS, *even when on land, breathe from six to twelve times and then stop breathing for a period lasting one half to a full minute.*

CHILDREN *have a keener sense of taste than adults.*

GLIDER CAN BE CARRIED IN SUIT CASE

Collapsible rubber glider being inflated with a hand pump. Below, how it is rolled up after a test flight



AN AMPHIBIAN glider recently tested at the Central Airdrome in Russia is blown up like an automobile tube, and can be collapsed and packed away in a suit case. Made of a special rubberized fabric, the odd craft is inflated through various valves with a hand pump in about fifteen minutes. A tailpiece of hard rubber, and other stiffening parts, give the necessary rigidity to keep the glider from collapsing under the stresses of flight. It weighs less than ninety-three pounds, is about twenty-six feet long, and has a wing spread of just over thirty-one feet. Controls are operated by means of ropes and the unique sailplane is said to be exceptionally stable and easy to handle while in flight.

DRUMKEEPSCORD FREE FROM KINKS

CONNECTING cords on telephones and electric accessories are kept from tangling by a spring attachment just marketed. A spiral spring rolls up all unused wire onto a revolving drum.

Telephone fitted with spring attachment to roll unused cord on a drum. This prevents tangling

TELEVISION STUDIO AIR-COOLED

ODD PIPES resembling the ventilators used on ships surround the stage of a new French television broadcasting studio. The tubes discharge a blast of water-cooled air across the stage, enabling the performers to remain comfortable despite the tremendous heat generated by the studio lamps. To permit a high quality of definition in the transmitted pictures, lamps totaling 48,000 watts are used, and it is estimated that without the ventilators they would raise the temperature of the studio to 140 degrees F.

Skull of "Homo Novusmundus," or New World Man, whose bones were found near Folsom, N. Mex.

J. D. Figgins, director of the Colorado Museum of Natural History, with a bust of the prehistoric man based on measurements of the skull and jaw bone also seen beside him

DROUGHT UNEARTHS

The First American

Bones Found in New Mexico Throw New Light on Prehistoric Life

ON THE TRAIL OF THE PAST

Scientists examining a deposit of mammoth bones laid bare by erosion. Below, note the spearhead found between ribs of an extinct bison

IN THE "Dust Bowl of the Southwest," the region most affected by the great drought of 1933, wind and erosion have brought to light the bones of what is thought to be the first American.

A party of relief workers, sent out by the Government to poison grasshoppers, stumbled upon the remains of the prehistoric man near the Cimarron River, eight miles east of the village of Folsom, N. Mex. The skeleton had been buried beneath nearly twenty feet of earth and bowlders. J. C. McKinley, leader of the party, forwarded it to the Colorado Museum of Natural History, at Denver. Here, the director, Jesse Dade Figgins, has studied the bones and has reported they are those of a stone-age American to whom he has given the name "Homo Novusmundus," or "The New World Man."

The scientist pictures this earliest known dweller on the North American Continent as about five feet, seven inches in height with a massive neck supporting a head quite unlike that of any modern man. Set above the eyes were heavy ridges of bone from which the forehead receded sharply. The underdeveloped chin resembled that of an ape and the walk of the New World Man is described as a crouching shuffle.

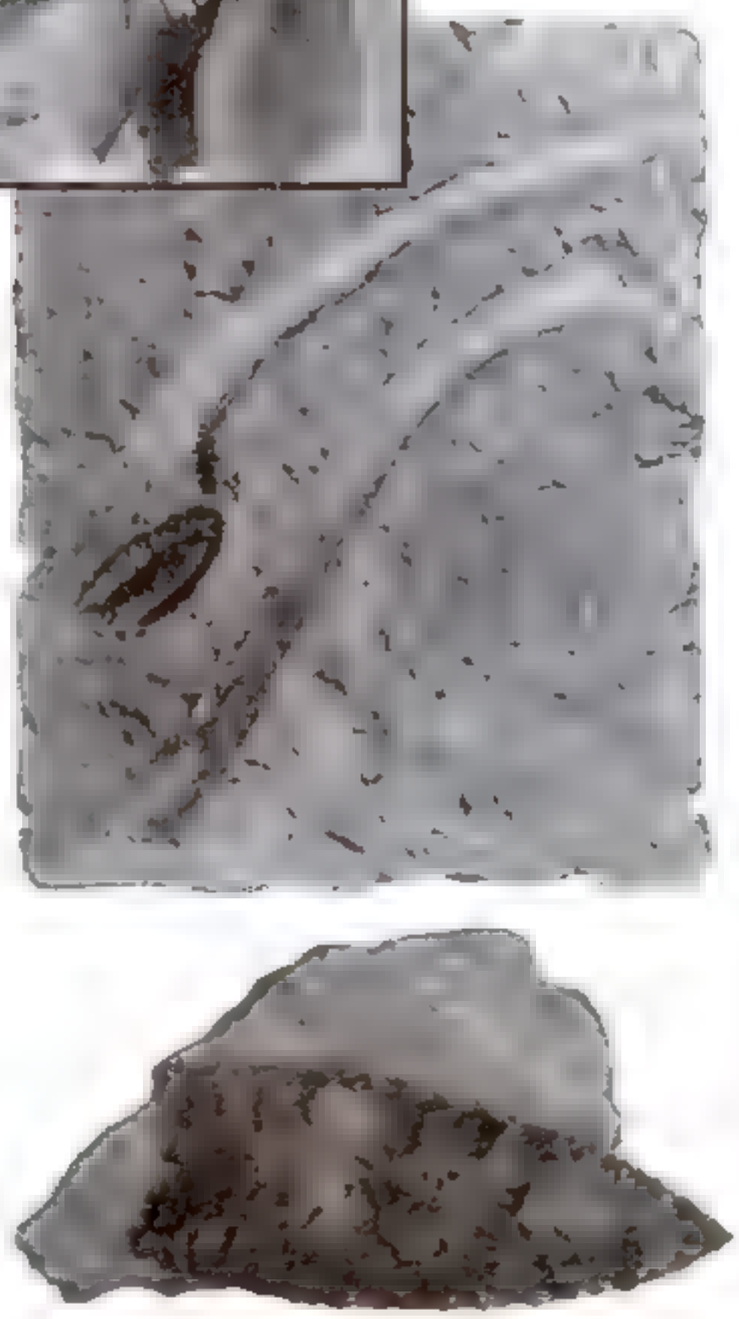
Because the discovery was made only a few miles from the Folsom desposits, where, nine years ago, the earliest evidences of human occupation of America were uncovered, it is suggested that "Homo Novusmundus" may have been one of the mysterious Folsom people supposed to have inhabited the Southwest between 15,000 and 50,000 years ago.

Even before the great drought of 1933, several unusually arid summers and severe fall floods increased erosion and thus aided the archaeologist by bringing to light stone-age relics and prehistoric fossils.

In 1931, a freshet tore away a section of the bank of a stream running through the farm of Ross Brooks, in Nuckolls County, Neb. It exposed the skeleton of a mammoth, buried under sixteen feet of soil. When the bones were exhumed, a spear point, like those made by the Folsom people, was found under one of the shoulder blades. The next year, another deposit of mammoth bones was unearthed near Dent, Colo. Again a Folsom spearhead was found, showing the monster had met its death at the hands of prehistoric hunters. These finds were the first to prove that the Folsom people lived contemporaneously with mammoths.

After dust storms had carried away millions of tons of topsoil, farmers all over the Middle West discovered fragments of prehistoric bones and implements. Recently, Dr. Barnum Brown, famous dinosaur collector of the American Museum of Natural History, in New York City, completed a tour of Oklahoma, Texas, Kansas, and Missouri, searching for fossil remains uncovered by the dust storms of the drought period.

Thus, the ill wind of the drought, which brought hardship to the farmer, has aided the research of the paleontologist.



A spear point of the type used by prehistoric hunters, still embedded in a matrix of stone

Luxury Trailers CREATE NEW ARMY OF Modern Gypsies

Young trailer tourists picking poppies by a western road

AMERICA'S homes are rolling

Fully 1,000,000 people this year will step into 250,000 comfortable, house-type trailers and speed away to distant scenes—the majority for pleasure; some for business

Seven years ago, trailers in which you could live as you traveled were virtually unknown. For four years, the public looked on them with skepticism.

Then trailers caught on. Three years ago, they swept the East in a single season. Quickly the trailer boom rolled across the continent. Today, in every section you'll see these single-room houses—complete homes, from dining room to kitchen—zipping along the highways performing all sorts of services, from carrying the family on vacation into the mountains, to supplying display rooms for salesmen.

The very strangeness of the jobs they perform proves their utility, comfort, and economy. Preachers preach from them; actors use them as dressing rooms; workmen club together and use trailers as economical and easily portable homes; families use them as spare bedrooms, sleeping as many as six in a single unit.

Traveling homes and workshops—at a cost of no more than a fourth of a cent a mile!

Recently, I sought out for the readers of POPULAR SCIENCE MONTHLY some of these trailer tourists, hoping to find out where they were going—and why.

"How much does trailer travel cost?," I asked. "What do you get for your money? Is traveling by trailer really pleasant and comfortable? For what purposes can people use trailers?"

Dish washing is a simple task in this traveling kitchen. At left, a trailer of streamline design

America Takes to the Open Road for Business or Pleasure in Amazing New Homes on Wheels

By *Andrew* R. Boone

The answers I got are interesting. Trailers have become far more than makeshift trucks in which to carry a fly rod, gun, and camp equipment. With them, you need no tent. Trailers, even the house kind, will travel virtually anywhere you can go. They're more, even, than just a means to a vacation. Suppose we take the last question first. Who's doing what with trailers?

Jack Bartlett, Tucson, Ariz., showman, recently purchased a trailer for $395, loaded into it a trained donkey weighing 800 pounds and a trunk containing fifty horned toads. With these as his performers, Bartlett tours the southwestern United States staging toad races and exhibitions of animal intelligence in hotel lobbies and schools.

Francis Olmstead, a writer for motion pictures, lives in his trailer, stopping on the desert or in the mountains, when the spirit moves him, to pound out his scripts far from Hollywood. A signal-maintenance crew on a railway between Los Angeles and Salt Lake City, travel in a trailer, pulling off the highway periodically to examine and repair ailing units. Not long ago, the president of a hotel company arrived at a hotel-men's convention—in a trailer. In Ypsilanti, Mich., a commercial photographer maintains a fleet of three mobile photographic trailer studios, complete with artificial lights and ventilation equipment.

An eastern man and his wife have set up a miniature toy factory and travel along the Atlantic seaboard selling their products to small-town merchants. Several artists use their trailers as studios

Think of some odd use for a trailer, and likely some one, somewhere in the United States, already has been struck by the same idea.

An itinerant minister, traveling through sparsely settled sections of the West, has converted a house-type trailer into a portable church. He seats a dozen people, preaching from a small chapel and pulpit at one end. A woman evangelist, Mrs. Julia A. Locke, tours the country in her trailer, preaching from a platform while music is provided by a bungalow-type piano carried within.

Many trailers are traveling restaurants. M. L. Skinner of Rochester, N. Y., operates a hot-dog stand from one end of his, and lives in the other. Living quarters and restaurant are separated by swinging doors. He earns a good livelihood as he travels carnival circuits, selling to carnival people and public alike.

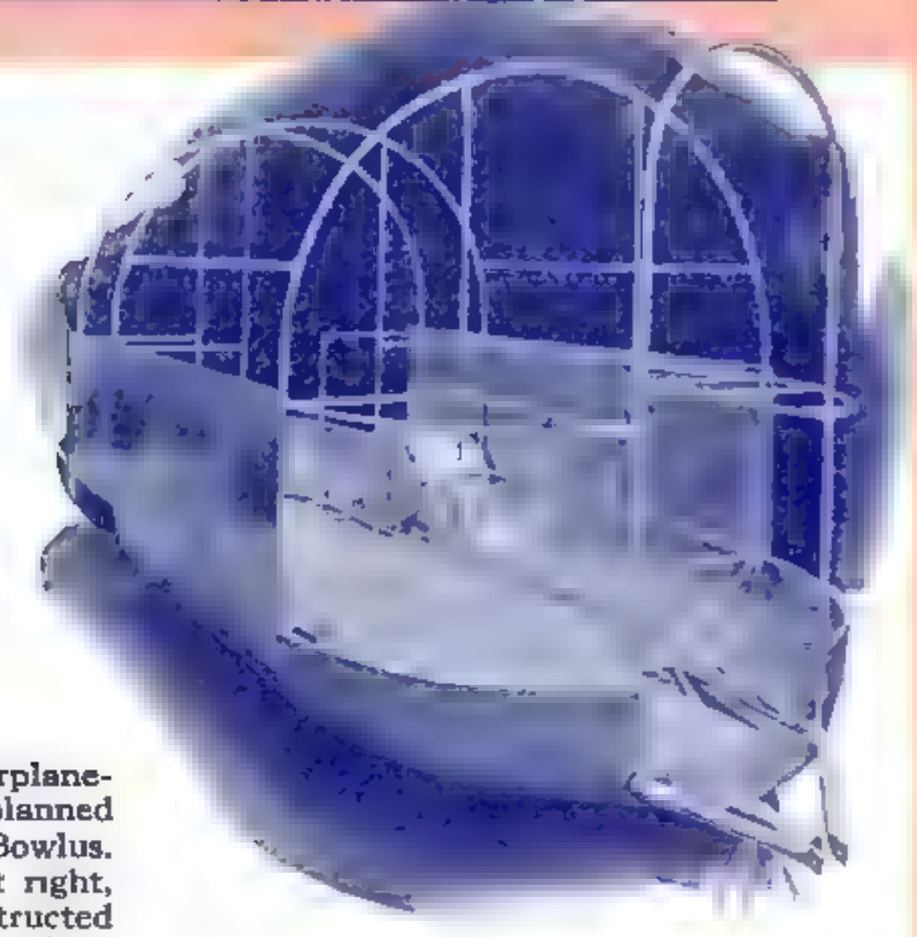
One salesman, minus both legs, overcame his handicap by moving from town to town and selling time switches, using the coach to display his wares. His assistant, who likewise serves as chauffeur, drives the trailer to the front of a prospect's office and invites him to see the display. The request is so unusual that few decline. A pleasant chat usually results in a sale. Again, half the rolling house is equipped as a bedroom and kitchen.

More than one family has abandoned the city to combine business with pleasure in a trailer. Accompanied by his wife, Roy L. Haslett, demonstrator of fishing tackle, drives 20,000 miles yearly, home and business headquarters never more than ten feet distant from the steering wheel. H. K. Lewis and members of his family tour the United States every year giving professional theatrical performances. They park the trailer near the theater, don costumes and grease paint, and walk through the stage door ready for a performance. George Bucey, who sells women's clothing, carries 1,800 dresses on racks in his rolling salesroom, and displays them to prospective purchasers at the curb. At night, he curtains off the samples and enjoys the comfort of his rolling home.

Four workmen engaged in constructing gas lines in the Middle West save

This roomy vehicle carries motion-picture personnel and equipment for making colored short features

A tourist pumping up the air-pressure tank that supplies water to the sink. The coils serve the refrigerator unit



Above, an airplane-type trailer planned by W. H. Bowlus. As shown at right, it is constructed like a cabin plane

rent as they move from job to job by "batching" in their trailer. Instead of paying rent of sixty dollars or more a month, they live in their trailer for less than five dollars. Elsewhere, families beat the high cost of living as they follow seasonal occupations in the beet fields of Colorado, the Texas cotton plantations, berry farms of Kentucky, and California's fruit groves, by living in trailers.

Some astounding mileages have been rolled up during the short time trailers have been in vogue. Virgil Dickie, of Detroit, has covered the amazing distance of 200,000 miles in five years, at a trailer cost of slightly more than one fourth of a cent a mile. I heard of a dozen other veterans, each of whom has gone far enough to girdle the globe four times.

You can cook, eat, and sleep in comfort while skimming along at sixty miles an hour in a lightweight, well-balanced trailer, or while stopped in the sun on a burning desert or in heavy snow. Weather means nothing to these rolling homes. It has become a common occurrence for meals to be prepared on the fly, to be eaten when the built-in telephone announces "dinner" to the driver. He pulls up alongside the road, walks twenty feet to the trailer door and partakes of a meal, the equal of any prepared at home.

In a trailer, your family can ride virtually twenty-four hours a day without undue fatigue. One man solved the problem of driving a long distance in a short time by taking the wheel during daylight hours while wife and children slept. She called him back for dinner, which she cooked as they rode, after which she drove while he washed the dishes and tucked the children into their beds. After a refreshing nap, he again took the wheel.

W. H. Kellogg, associate professor of psychology at Indiana University, recently made an 8,000-mile trip into western parks. Once, desiring to get through some uninteresting country in a hurry, he drove all night, while Mrs. Kellogg and the two children slept. Again, he stopped to buy apples from a farmer; Mrs. Kellogg busied herself with the collapsible oven and 100 miles farther on sounded the buzzer to announce the pie was finished. For ten weeks, the Kelloggs never had a meal away from their trailer.

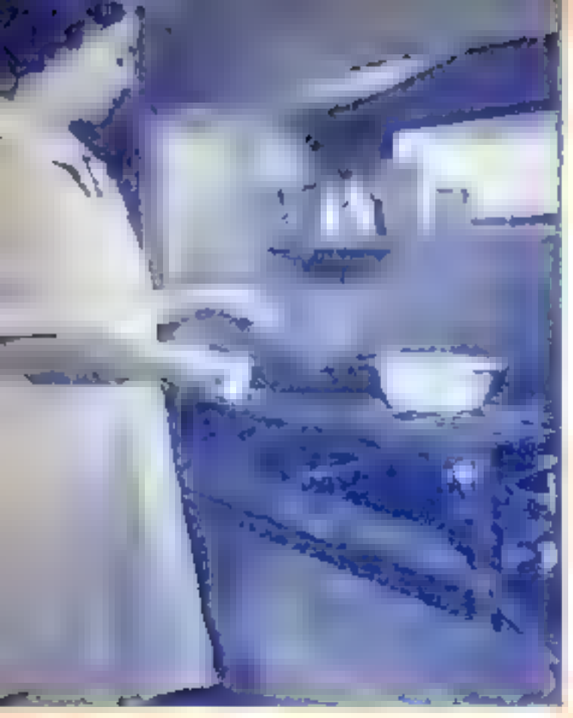
"It was by far the most enjoyable vacation we ever had," he said, "as well as one of the cheapest. We had no rent or hotel bills to pay and the food expense was the same as if we had been at home. Our only extra expense was for gas and oil."

In another three or four years, trailer manufacturers predict, fully 1,000,000 rolling houses will be following lanes and highways, carrying owners from colder to

Collapsible model with roof raised and side walls being lowered for beds. At right, the outfit folded

A "home on wheels" on a Nevada road in winter. Built-in heating and air-conditioning units provide comfort under all climatic conditions

A city of trailers—a tourist park at Sarasota, Fla., with nearly 1,000 units assembled for the convention of a trailer organization. Many camps now provide facilities for this type of travel



In a modern rolling home. At the left, the "housewife" is cooking over a gasoline stove. A ventilator removes fumes. Meals are served on a folding wall table, and Pullman-type beds provide comfort. Note the built-in, bedside radio

warmer climates, into forests, along coastal highways, and across mountains.

The reason for this prodigious increase is partly economic. "With the rising cost of real-estate taxes, it is only natural that people are seeking new means of cutting down their living expenses," one man who has built several hundred trailers told me. "The man living on a small pension, for instance, can live in a property-tax-free rolling home, moving whenever and wherever he chooses, on an income of fifty dollars to $100 a month. He may reside in a southern state during the winter at no greater cost than his coal bill in the North.

"Another large group who eventually will come to trailers are the owners of summer cottages, who will find in the trailer a cottage which can be transported to more desirable locations. Others who will come to occupy these portable homes are those suffering from heart ailments and other diseases which can be helped by climate and altitude. People who have some spare time during part of the year are turning by thousands to trailers—show people, teachers, and athletes, for instance."

The typical trailer of today is a one-room affair, with the kitchen usually a part of the combination living-dining room. As the vehicles become more popular, they are rapidly changing form. People who start this season with an inexpensive unit, next year will be adding electric refrigeration, shower baths, and hot water. Next, they will divide their single room into two or three. Then will be achieved the real homes on wheels.

Trailers probably will never exceed twenty-five feet in length, no matter into how many rooms they may be divided, for taxes in many states skyrocket when that length is exceeded. From my conversations with a score of manufacturers, I think the trailers of next year and the year after will rival airliners in the comforts and conveniences crowded within a small space. Too, you will be able to store a small trailer with your car in a single garage, while a double garage would be required for the larger, more luxurious type.

Here are some of the things you'll get as trailers advance: Even the small, less costly units will have full air conditioning for comfort in both summer and winter. The majority will be streamline and weigh less than the present average of about 1,300 pounds. Most of them will come equipped with radios, while light-metal-alloy body construction is gaining in favor. All will have easily cleaned upholstery and beds as comfortable as you'll find in good hotels. More expensive trailers will be equipped with brakes operated from the driver's seat, and the majority will be soundproofed.

Meantime, how much do you have to pay for a trailer, and what will you get for your money? The range is wide, from $100 for the simplest kind of camping-type trailer to $14,000 for a de luxe house trailer with beds for six people. In the former, you get little more than a two-wheeled truck for carrying your bed and other supplies, while the latter boasts electric refrigeration, air-conditioning equipment, insulation against heat and cold, telephone system between trailer and car, ice water—all the comforts of home.

For $395 you can purchase a comfortable house trailer, finished to match your car, with a bed for two, plus a dresser, sink, and water piped to the sink. With good care, such a unit will give satisfactory service a decade or longer.

If you wish to add $100 to the purchase price, you'll get a similar unit, with sleeping accommodations for four—one double bed and two singles for the children.

Step up the price to about $795, and you'll find yourself contemplating a fine mahogany interior finish; taking food from an ice box; sleeping in a Pullman-type bed; cooking meals over a three-burner gasoline stove whose fumes escape through a ventilator in the roof; drinking water piped from storage tanks to a hand pump at the sink, which is hidden under a cutting board; and using a separate dressing room and compact closets to keep your clothing clean and neatly pressed.

While that unit carries no brakes, if you wish to climb into the $1,500 class, vacuum brakes will be added, plus electric refrigeration, a portable electric-light plant, gasoline range and fuel tank with capacity for twenty days, nine-tube radio, sleeping accommodations for as many as nine, electric fans, linen lockers, embossed linoleum floor (easily kept clean), an extra wash bowl, medicine cabinets—and a peeper in the door to permit inspection of callers.

Once paid for, your trailer will cost you little except a slight increase in the gasoline consumption of your automobile. A. L. Clements, a Chicago manufacturer, bought a second-hand trailer. During a trip of 1,407 miles into the Smoky Mountains of Tennessee, which included 800 miles of mountain driving, he found it cost him $1.10 more a thousand miles for gas and oil when pulling his trailer. Where he averaged fif-

(Continued on page 127)

A "teardrop" trailer designed to accommodate two persons. Below, one of the smaller units that have cooking facilities at rear

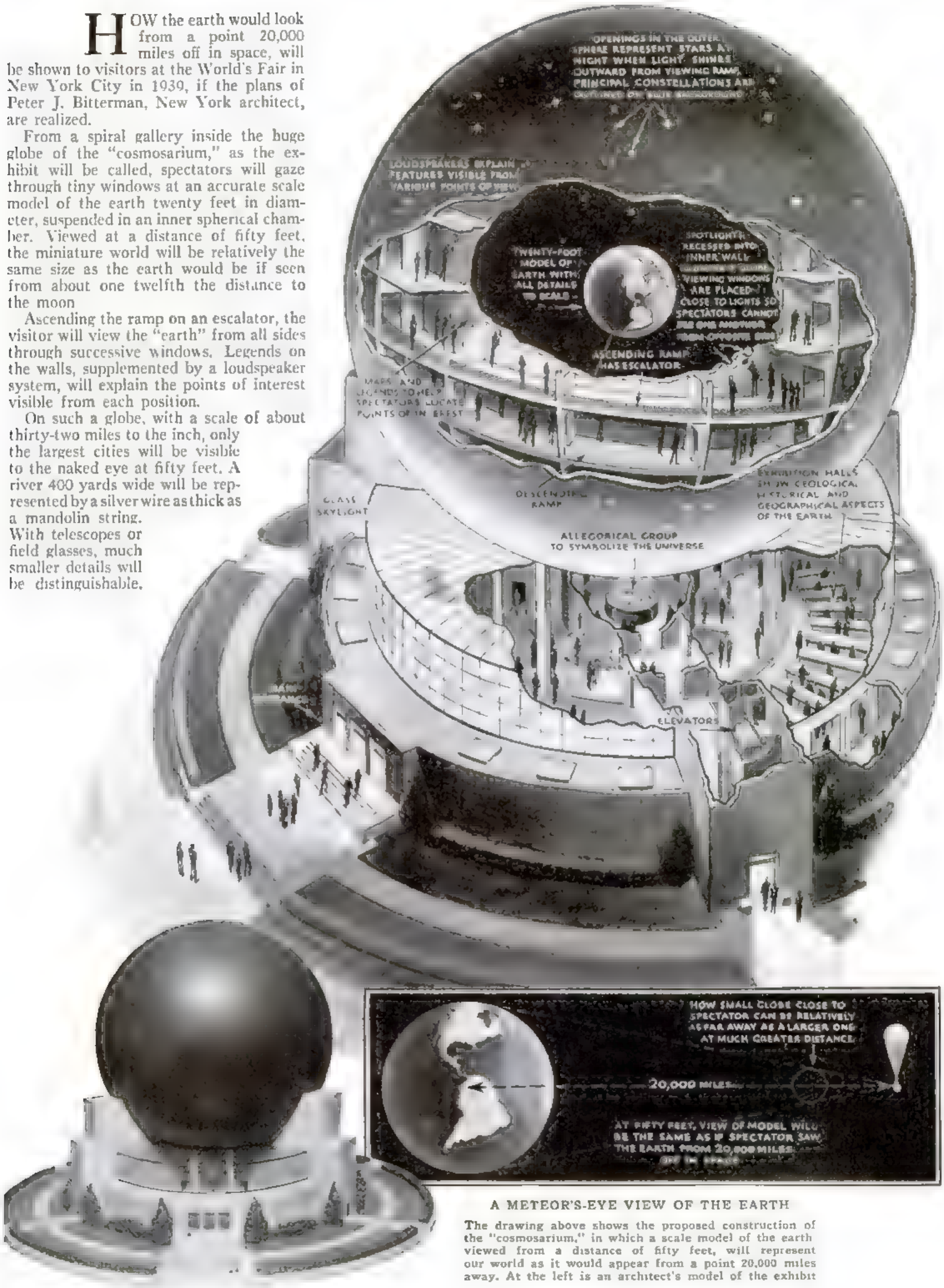
Odd Exhibit to Show Earth in Space

HOW the earth would look from a point 20,000 miles off in space, will be shown to visitors at the World's Fair in New York City in 1939, if the plans of Peter J. Bitterman, New York architect, are realized.

From a spiral gallery inside the huge globe of the "cosmosarium," as the exhibit will be called, spectators will gaze through tiny windows at an accurate scale model of the earth twenty feet in diameter, suspended in an inner spherical chamber. Viewed at a distance of fifty feet, the miniature world will be relatively the same size as the earth would be if seen from about one twelfth the distance to the moon

Ascending the ramp on an escalator, the visitor will view the "earth" from all sides through successive windows. Legends on the walls, supplemented by a loudspeaker system, will explain the points of interest visible from each position.

On such a globe, with a scale of about thirty-two miles to the inch, only the largest cities will be visible to the naked eye at fifty feet. A river 400 yards wide will be represented by a silver wire as thick as a mandolin string. With telescopes or field glasses, much smaller details will be distinguishable.

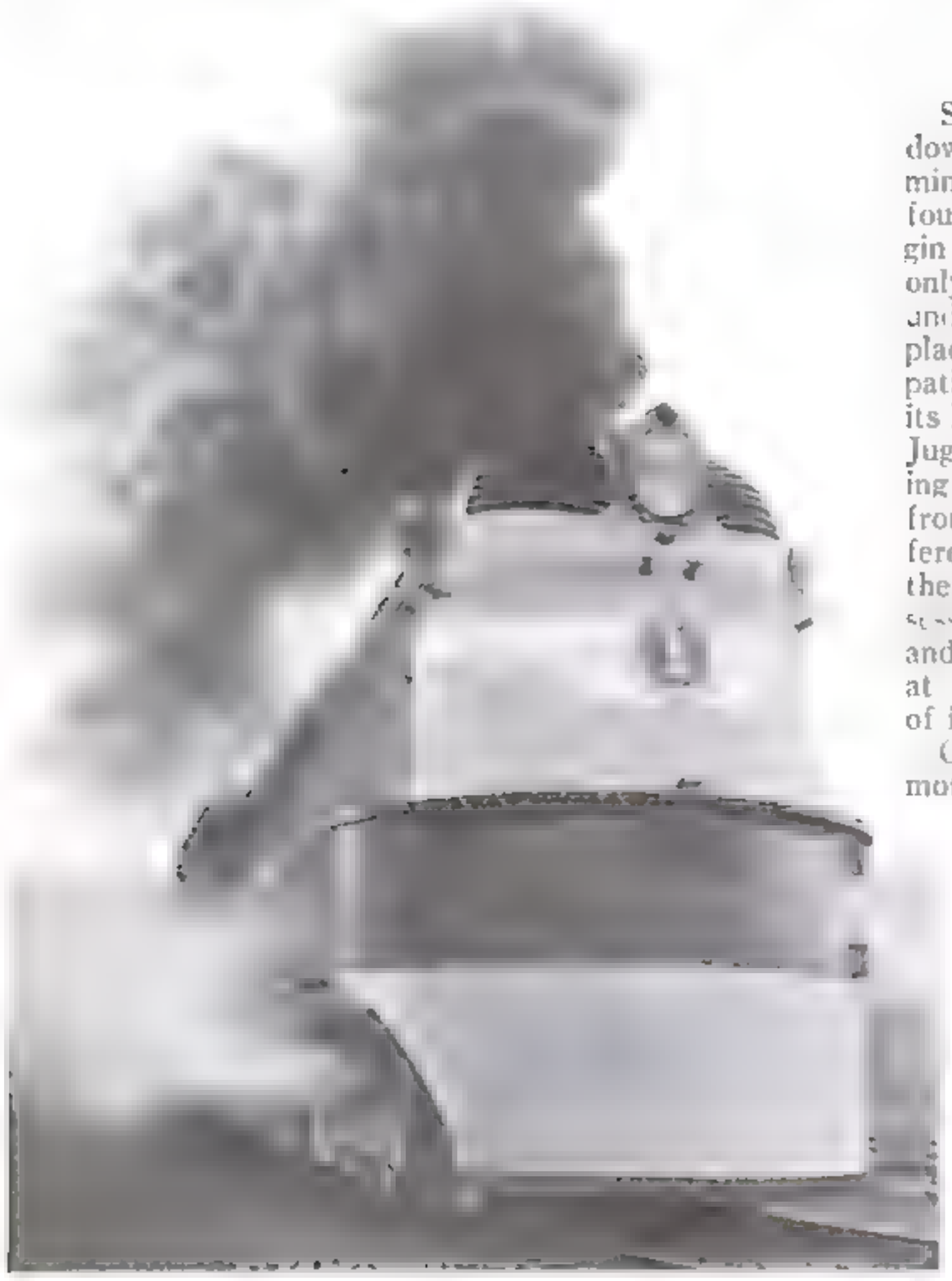


A METEOR'S-EYE VIEW OF THE EARTH

The drawing above shows the proposed construction of the "cosmosarium," in which a scale model of the earth viewed from a distance of fifty feet, will represent our world as it would appear from a point 20,000 miles away. At the left is an architect's model of the exhibit

• STRANGE RAILROAD TESTS PROMISE

Two-Mile-a-Minute Trains



This streamline steam locomotive, capable of making 120 miles an hour, is typical of the monsters being placed in railway service

By ALDEN P. ARMAGNAC

HOW fast can a railroad train go, with safety? To find out, Pennsylvania Railroad engineers have been sending electric locomotives and cars hurtling over a proving track near Claymont, Del., at speeds up to two miles a minute, while sensitive recording instruments registered every lurch or tremor. The novel tests mark the opening of a new line of research that brings unprecedented speed on rails—perhaps 150 or 200 miles an hour—within the realm of speculation.

With records constantly going by the board as railroads strive to improve their service, the speed mark for a fully equipped train is claimed at this writing for one of the Burlington Line's Diesel-powered streamliners, which is reported to have maintained for several miles the terrific speed of 122 miles an hour. Beyond this figure lies the record of 156 miles an hour set in Germany, a few years ago, by a rocket-driven rail car—as far as available records show, the fastest thing ever to travel on rails.

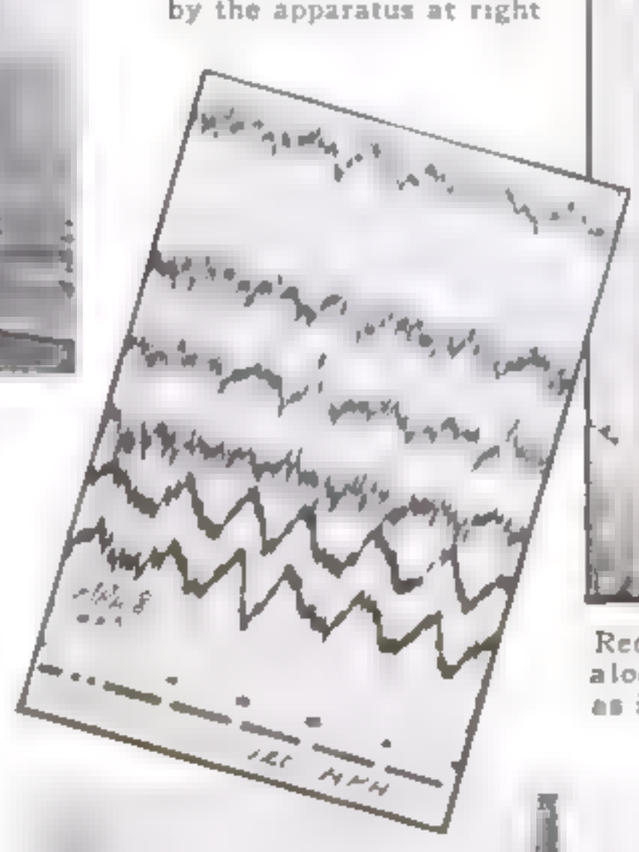
Today, a locomotive could undoubtedly be built that could haul a train at equal or greater speed—and do it without recourse to any form of propulsion as unconventional as rockets. Whether it could be kept from jumping the track, however, would be another matter. This helps to account for the fact that present-day railroad trains, even the latest streamline flyers, are operated on scheduled runs at speeds far below those of which they are physically capable.

Send a locomotive roaring down a track at two miles a minute, research workers have found, and curious things begin to happen—things that are only now commencing to be understood. No longer is it a placid, elephantine monster, patiently plodding along with its load. It has become a mad Juggernaut, lunging and shaking in an effort to free itself from the confining rails. Different locomotives, even of the same design, seem to possess individual personalities, and each one shows odd traits at a certain "critical" speed of its own.

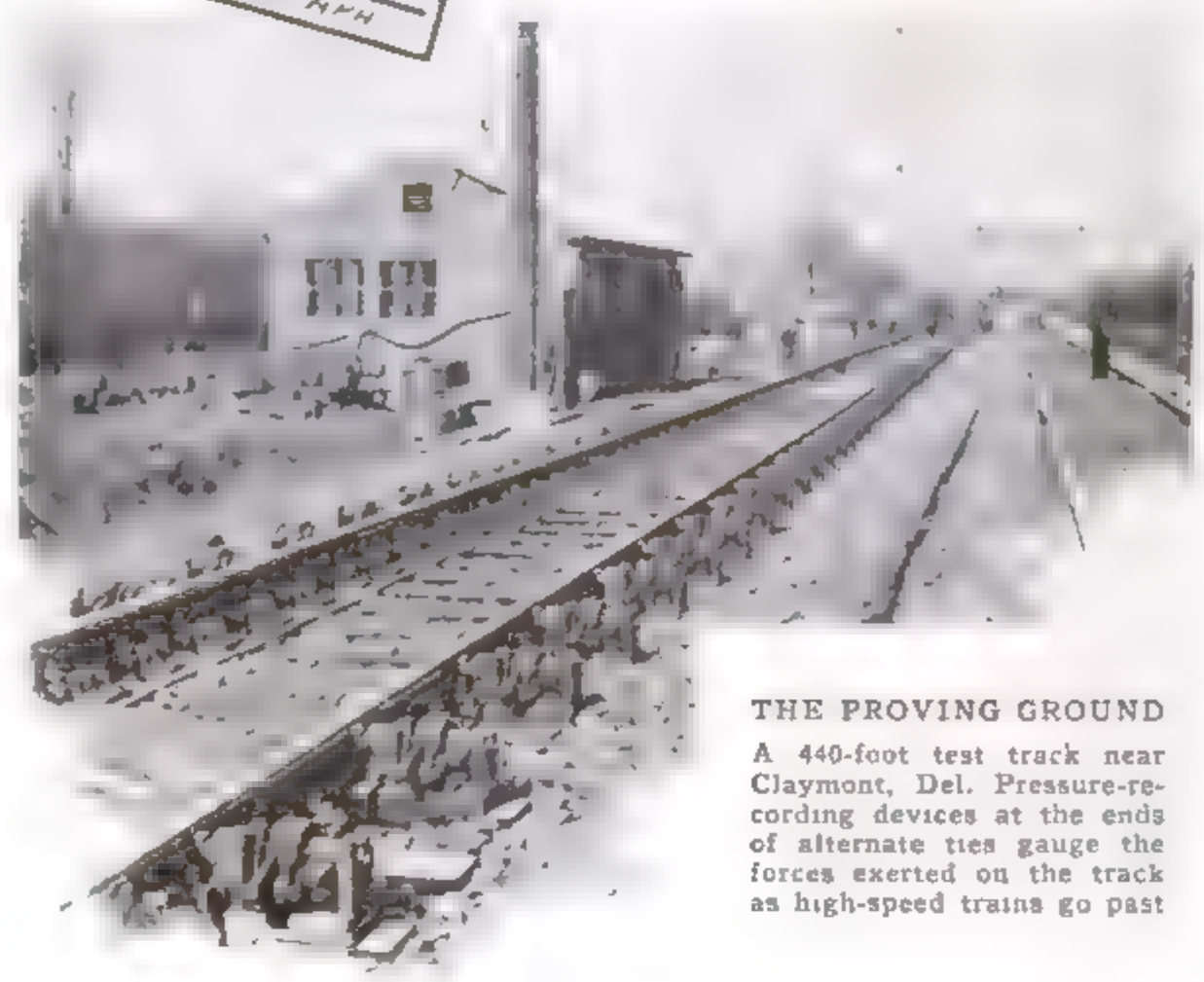
One of these traits is a motion known as "rolling," resembling that of a ship in a heavy sea. Slight inequalities in the track bed start the locomotive rocking from side to side. At the critical speed of the engine, which is closely related to what engineers call its period of vibration, this rocking reaches a violence that threatens to derail it.

"Nosing" is the name given to another motion peculiar to speeding lo-

The wavy lines on the chart below record the behavior of a locomotive in a high-speed test, as registered by the apparatus at right



Recording apparatus installed in the cab of a locomotive to measure pressures at the hubs as it thunders down the track in a trial run



THE PROVING GROUND

A 440-foot test track near Claymont, Del. Pressure-recording devices at the ends of alternate ties gauge the forces exerted on the track as high-speed trains go past

Fast New Locomotives Roar Over a Novel Test Track As Instruments Record Their Behavior To Fix Speed Limits For the Crack Flyers Of Tomorrow's Travel

• •

An experimental streamline electric locomotive which was approved in novel tests made on a proving track

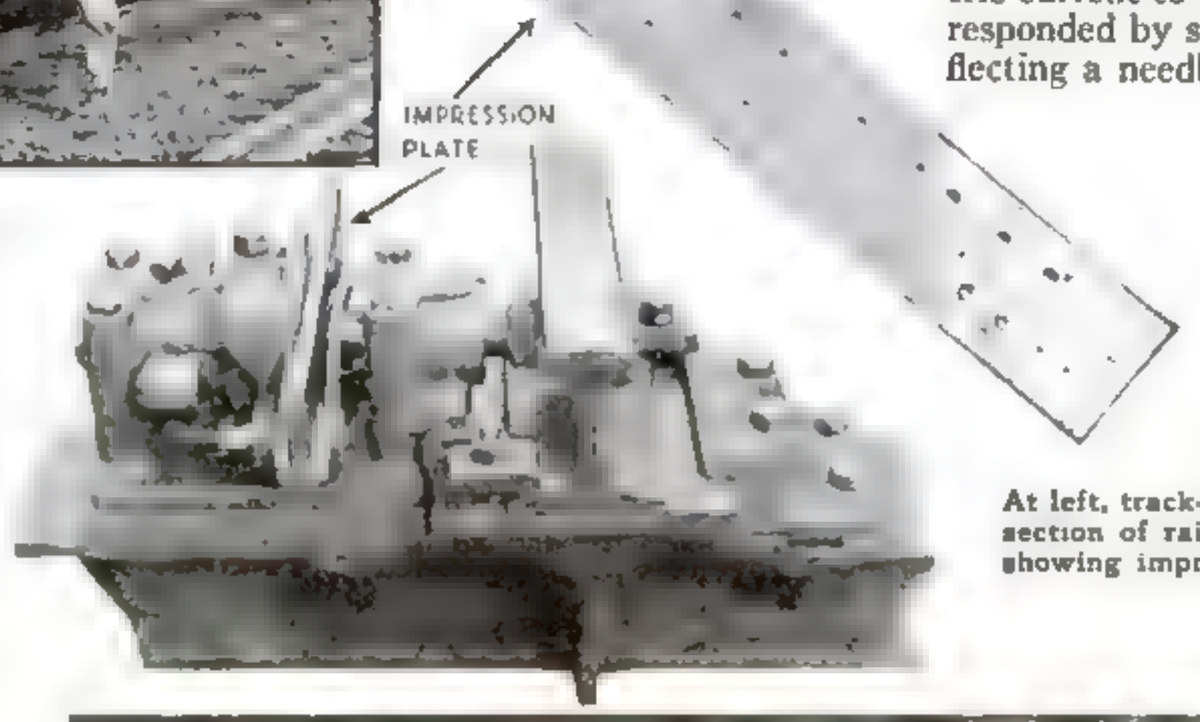
comotives. This occurs as a result of the play between the wheel flanges of the locomotive and the track on which they ride; a certain margin must necessarily be allowed so that the wheels will not bind. When a critical speed is reached, the random impacts of the wheel flanges against the sides of the rails set up a periodic, snakelike movement. Tossed from side to side, the locomotive will jump the track unless the motion can be checked.

Railroad men have known of these phenomena and similar ones, but it is only recently that any systematic effort has been made to study them and find a remedy. The incentive came when the Pennsylvania Railroad decided upon complete electrification of more than 200 miles of main-line track between New York and Washington, inaugurating a new high-speed passenger service. Virtually unlimited electric power available, officials realized, made almost any running speed theoretically possible. What should be the actual speed limit?

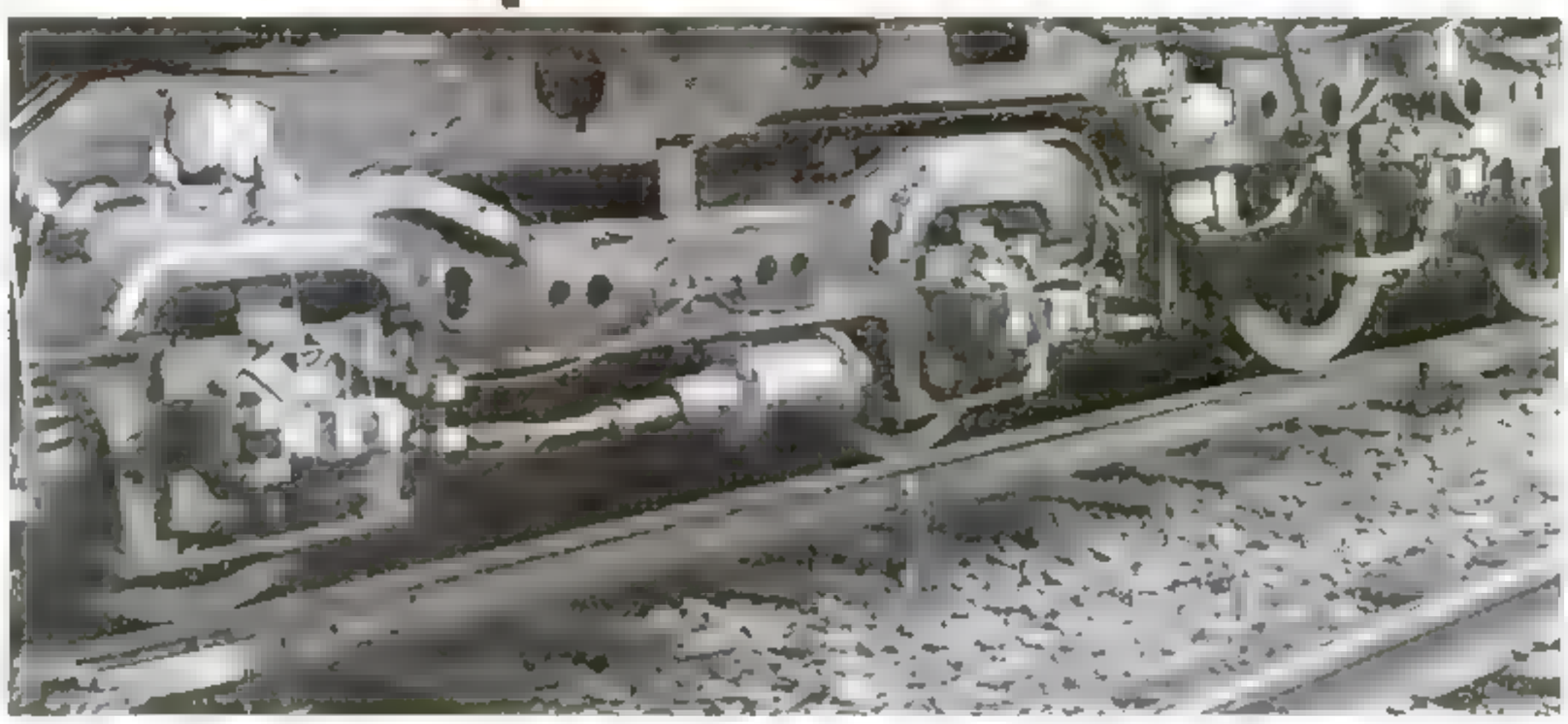
Since no exact measurements existed showing the forces tending to derail a speeding locomotive, Pennsylvania Railroad engineers proceeded to make them. For a proving ground, they built into the main line near Claymont, Del., a special 440-foot section of test track, with steel ties. Every other tie carried an ingenious pressure recorder to register the sideward pressure of a passing locomotive against the rails. Any lateral movement of the rail would force a hardened steel ball, mounted in this device, against a softer plate of iron. By measuring the depth of the resulting dent, the force or thrust causing it could be gauged with great accuracy.

Electric locomotives of the type then in use, known as the P-5, were sent over the track at high speed, hauling "dummy" trains made up exactly like regular passenger trains. For some of the trials, the test stretch was artificially roughened to give the locomotive a bumpy ride, magnifying the effects observed. At the close of each day's test runs, the impressions on all the plates were measured, yielding a graphic picture of the mysterious forces lurking in a locomotive's wheels.

A question mark remained, however. The tests showed the maximum pressure at each recording tie, but they failed to reveal which wheel of the locomotive caused it. So engineers installed electrical pressure instruments on the wheel hubs of the locomotive itself, and led wires from them to a battery of recording instruments in the engine cab. As the locomotive coursed down the test track, variations in pressure at each hub caused the associated instrument to transmit a fluctuating electric current to the cab. Here a tiny mirror responded by swinging back and forth, reflecting a needlelike beam of light upon a moving photographic film. The resulting charts, resembling seismograph records of an earthquake, gave a complete picture of the locomotive's behavior. Interpreted by skilled analysts, they revealed the hitherto unsuspected fact that the P-5 type of locomotive would benefit materially by alterations in its trucks and redistribution of its weight. When the changes were made, the obvious improvement in its riding qualities silenced any remaining skepticism concerning the value of the experiments.

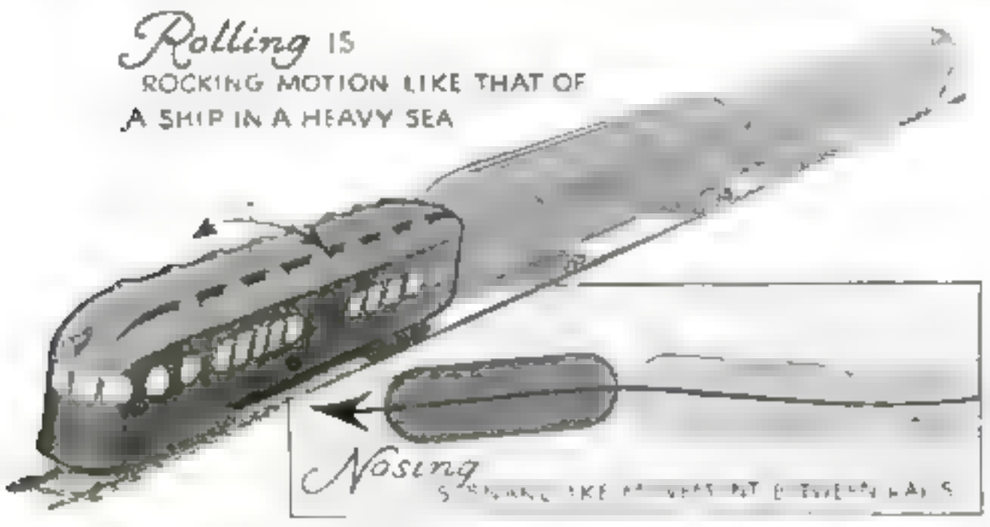


At left, track-pressure recorder with section of rail. Above, record plate showing impressions made in trials



Wheel hubs of an experimental locomotive, with electrical apparatus that gauges stresses on wheels

From the experience gained in these tests, the engineers concluded that it was possible to design a locomotive capable of hauling its high-speed passenger trains at a sustained speed of ninety or even a hundred miles an hour with complete safety. Before the final selection of the type of engine to be used, two experimental locomotives of slightly different design were built, known respectively as the R-1 and the GG-1 types. These underwent the same tests as their predecessors, at speeds up to 120 miles *(Continued on page 124)*



At high speeds, locomotives tend to "roll" and "nose." These motions increase gradually until they may cause a derailment

Dare-Devil Boy Pilot

HAS THRILLING ESCAPES IN RECORD FLIGHTS

Frank Kurtz's trim biplane *Yankee Boy* in the air over the rugged mountains of Mexico

WHO holds the world's junior land speed record for airplanes? Frank Kurtz.

Who holds the junior "three-flag" record from Canada down the Pacific Coast to Mexico, the junior flight record from Southern California over treacherous mountains to Mexico City, and the junior record set in a life-threatening flight from Mexico City to New York City?

Again: Frank Kurtz.

This young aviation student at the University of Southern California has packed more thrills and fame into his short flying career than many an older pilot. Before breakfast, after dinner in the evening, during vacations, he has rolled up since his first flight five years ago the staggering total of 1,000 hours in the air. His records prove that younger boys can take to the air with safety in ever larger numbers.

Kurtz might well be called the Lindbergh of the younger aviators, for in piloting his *Yankee Boy* during long flights, he navigates by "dead reckoning," as did the Lone Eagle on his historic New York–Paris crossing. He studies weather reports, figures the effect of winds, calculates a compass course which should land him at an objective hundreds of miles distant, and, after long and careful preparation, takes off.

Drama rides with this young flyer as he dares to hop into the sky at night on a hazardous flight of a thousand miles or longer. Death has threatened him more than once. He carries no radio, and relies only on his engine and careful navigation to carry him through; on a discarded automobile inner tube, spotted by many patches, to save him should he be forced down on water.

On any one of a half dozen occasions, his career might easily have been ended had he made a wrong decision. There was the night, for instance, when his cowl lights failed while he was flying over Puget Sound; the afternoon he fell asleep over Mexico's treacherous mountains; another afternoon when winds held him back and almost forced him to land in the Gulf of Mexico; the day when he landed on a Wyoming hill, into the teeth of a seventy-mile gale.

His first test of nerve and skill came shortly after taking off from Landsdowne Airport, Victoria, British Columbia, at 3:20 A.M., headed for Agua Caliente, Lower California, 1,200 miles distant as a long-range crow might fly. Immediately ahead lay Puget Sound. Kurtz had calculated that fifty minutes would carry him safely across the sound. Five minutes out, as he was checking his compass to make sure he was on his course, the lights on his dashboard flickered and died. He reached for his flash light, intending to throw its beam on the compass. But the lens fell from the light and rolled back to the tail.

Flying only 150 feet above the water, the young aviator could not dive the ship in an effort to roll the missing glass back to his feet, so he did the next best thing: he continued what he thought and hoped was his proper course. Twenty-five minutes later, he picked up the Port Angeles lighthouse, and knew then he was flying close to his planned course. Eleven hours and one minute (flying time) after his spinning wheels rose from Canadian soil, he set his little Waco down on the Mexican field at Agua Caliente. While not fast time as long-range planes fly, this record was notable in that the little ship was not equipped for long hops, and Kurtz sat down for gasoline five times as he proceeded southward.

But that flight was nothing compared with nerve-trying brushes with tragedy which awaited him during his record flight from Southern California to Mexico City. Anxious to complete the 1,900-mile hop to Mexico's capital in a continuous flight, stopping only for fuel, Kurtz rolled his little Menasco-powered Waco biplane out on the runway at March Field, the Army Air Corps post near Riverside, and shortly before midnight shoved the throttle forward. Heavily overloaded, the plane rolled slowly. Past the quarter-mile mark it wallowed, to the half-mile flag, past the three-quarter mile post and on a full mile before the wings caught and lifted him slowly into the air.

The pilot circled the field, climbed into the "moon" over the San Jacinto peaks, and set his course for Hermosillo, 700 miles south and east. At Mexicali, on the border 100 miles south of March Field, he checked his position for the last time by the light beacon. For five hours thereafter he flew on through the dark, crabbing slightly to overcome a twenty-two-mile-an-hour cross wind reported at Guaymas, wondering whether he would land at Hermosillo, or at some lonely spot in the Mexican wilderness.

"I was supposed to hit Hermosillo fifteen minutes after the dawn period broke,"

PLOTTING THE COURSEAHEAD

With the aid of an air-line pilot, the young aviator studies a map showing the country he will traverse on one of his junior-record hops. Like a veteran flyer, Kurtz always makes careful plans and preparations before taking off on a long or dangerous flight

Frank Kurtz, holder of many junior long-distance records, with his teddy-bear mascot

In Long-Distance Hops Over Deserts, Seas, and Mountains, Frank Kurtz Blazes An Air Trail for The Boys of America

By

JOHN E. LODGE

•

At a refueling stop on one of his flights, Kurtz directs the operation of filling the tanks, to avoid wasting time

Kurtz told me, in recounting his thrilling experiences. "Funny feeling, sitting there looking down 7,500 feet through the dark on a country I never saw before. Well, the dawn period came, and no Hermosillo. But luck was with me, and only three minutes after my scheduled time, I saw the Sonora River and the railroad. Boy, was that a relief! A couple of slips and I was down."

Kurtz checked out of Hermosillo twelve minutes late, and landed at Mazatlan, 500 miles distant, one minute ahead of schedule. Then the fun began. The intake of his gasoline tank was too small to receive the standard motor-driven pump nozzle, and, after hand pumping, he again took off, one hour behind time.

Mexico City lay 700 miles away, across as treacherous mountain country as any aviator would wish to look down upon and the young flyer opened his throttle wide in an effort to make up lost time. He already had checked the dawn and sunset periods carefully, and planned to reach Mexico City at the beginning of twilight, thus giving himself a safety factor of scarcely an hour. Seven hundred miles in five hours, in a ship having a top speed of 130 miles an hour. Could he make it?

Kurtz batted along, picking up precious minutes, until he began brushing the hills an hour out of his destination. Nearly overcome by fatigue, once he fell asleep, awaking a few seconds later to find *Yankee Boy* in a diving turn headed toward a jagged mountain. After that experience, whenever sleep threatened he rolled the stabilizer back to make sure the plane would climb, and not dive earthward.

Overloaded with extra gasoline and oil, the plane refused to climb higher than 9,000 feet, while the final range, towering 11,000 feet high, cut him off from the Valley of Mexico. Approaching the mountain range directly on course, he saw under his right wing a small, plowed corn field. Orienting himself carefully, he flew on, hoping to pick up the Mexico City beacon a few miles farther on. Ten minutes passed, and no sight of the light; so Kurtz swung his ship in a sharp turn and back-tracked to the field. There he indulged in what he calls "cowboy flying," diving twice on the field to scatter a herd of burros, then sat down, fully expecting to nose the plane up in the soft earth. But the plane landed heavily on its air wheels and jerked to a stop.

Friendly Indians brought him burros, and he rode for three hours at the head of a thirty-burro caravan to Maravatio, where he telephoned President Lazaro Cardenas of his safety. Returning to the field, he worked throughout the night dismantling the pants, flares, and any spare parts which could safely go overboard; dumped oil, baggage, 100 pounds of gasoline, maps, cushions, and vacuum bottles, and sent them down to Maravatio for rail shipment to Mexico City. Forty peons, intrigued by the daring of this sky voyager, gave him help in building a runway, knocking down corn and dragging a narrow strip between the stalks. As dawn broke, Kurtz finished the take-off strip, 380 feet long and scarcely a foot wider than his ship.

He waited throughout the morning for a head wind to help him in his take-off, and shortly after noon climbed into the cockpit.

"Gee, that runway looked short," he told me, "but it was a case of all or nothing. I couldn't stay there forever. At the end of the runway was a bump about five feet high, and in the valley beyond were some tall trees that didn't look any too promising. I opened the throttle wide, and the ship refused to budge, for she was still bogged down. The peons understood what I needed, though, and three took hold of each wing tip. As they waggled the wings I raced the engine. The ship finally got going and I streaked down the narrow lane. At the end I hit the rise, bounced out over the edge, and started falling.

"That was more of a take-down than a take-off, but I was in the air, at least for a moment. I dropped the nose and brushed over the trees while picking up speed. Luckily, the trees fell away downhill as rapidly as I descended, and after a few seconds I pulled up and away. This may not sound ticklish, but remember, I was taking *Yankee Boy* off from a tough field at an altitude of 8,200 feet. And that's no joke."

Fortunately, there was no down draft of air to force Kurtz into the earth, an experience he was to have later. He whipped along, pulled up past towering El Carbon, famous peak of Mexico, crossed the range, and landed at Mexico City, after flying sixteen hours and three minutes from March Field. His baggage completed the 120-mile journey by rail, and caught up with him seven days later. *(Continued on page 125)*

Tombstones Give Clews *to*

How a Half-Forgotten Theory, First Suggested by Japanese Stone Lanterns, Has Been Revived by Modern Disasters

In the wake of the Southern California earthquake of 1933. Fallen gravestones pointed out the quake center

EARTHQUAKE strikes a crowded city. Within a few minutes—perhaps only a few seconds—a modern community of 100,000 people has been reduced to wreckage. Clouds of dust and smoke rise from the ruins, under which are buried the mangled bodies of scores of victims.

As suddenly as they began, the tremors cease, and the earth again becomes firm and motionless. For the survivors there remains the task of relieving the injured and homeless, and repairing the damage. And for science there is a difficult piece of detective work to be done, in finding the source of the disaster and learning whatever lessons it may hold for guarding against such calamities in the future.

Once the true center of a shock is known, science has a chance to pull the teeth of the earthquake, and render it harmless. Cities in known earthquake zones may be rebuilt so that a second quake will do only minor damage. But the all-important epicenter of the quake must first be determined beyond question.

Strangely enough, it is in cemeteries that seismologists are now looking for clews to the origins of earthquakes. Tombstones, toppled over in apparent confusion, provide a trail by which the assassin can be tracked to his lair.

It is a fascinating story, the story of a half-forgotten theory which was revived during the disastrous Southern California quake of March, 1933. It is a theory which may be of material aid in tracking down the deadly fault in the earth's crust which brought destruction on Helena, Mont., in October, 1935.

The story goes back to 1891 and to a Japanese scientist, Fusakichi Omori. In that year, a series of earth shocks rocked the Mino-Owari district of Japan. Omori, then recently graduated from the Imperial University with degrees in seismology and meteorology, rushed into the devasted area to make observations.

He found hundreds of overturned stone lanterns. As he traveled through the ruins, something about the way the lanterns had fallen caught his eye. There was, it seemed to him, some sort of pattern in the directions of their fall.

Omori recalled a theory advanced more than thirty years before by Robert Mallet, father of seismology. In studying the Neapolitan earthquake of 1857, Mallet had attempted to calculate the center of the quake by the direction of fall of various objects.

Could not the same theory be applied to the lanterns?

"The lanterns," Omori said, "will fall parallel to the direction of the earth wave which displaces them. Therefore, if I draw lines in the directions of their fall and extend the lines both ways, I will have a basis for calculating the center of the quake."

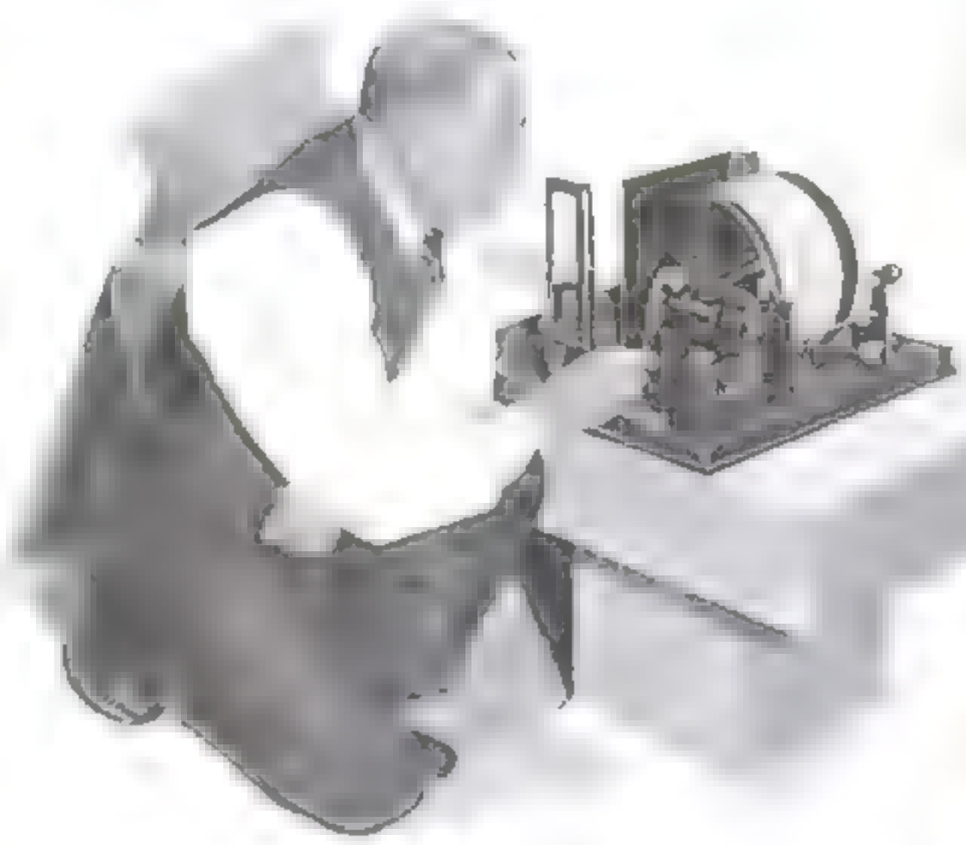
Omori drew his lines, calculated the epicenter of the Mino-Owari quake, and found it to lie in the area of greatest damage. Satisfied, he advanced a theory of columnar fall as a method of locating the epicenter of earthquakes.

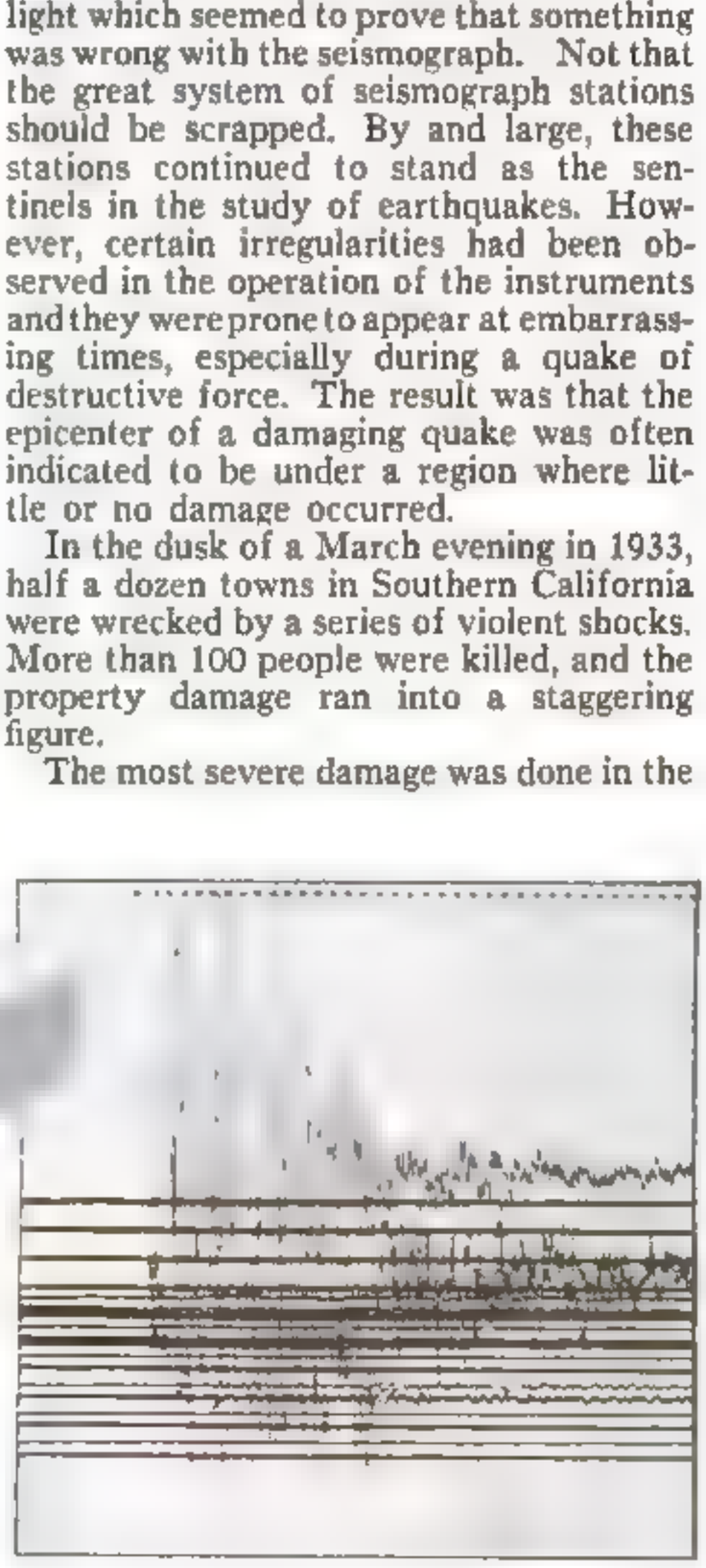
Then the seismograph came into wide use. It became possible to calculate the distance of a shock from a given instrument. By combining data from many seismographs, the epicenter of a quake could be found. Omori's theory of the tale of the fallen lanterns gathered dust in the attic of outmoded science.

As the years passed, quake facts came to light which seemed to prove that something was wrong with the seismograph. Not that the great system of seismograph stations should be scrapped. By and large, these stations continued to stand as the sentinels in the study of earthquakes. However, certain irregularities had been observed in the operation of the instruments and they were prone to appear at embarrassing times, especially during a quake of destructive force. The result was that the epicenter of a damaging quake was often indicated to be under a region where little or no damage occurred.

In the dusk of a March evening in 1933, half a dozen towns in Southern California were wrecked by a series of violent shocks. More than 100 people were killed, and the property damage ran into a staggering figure.

The most severe damage was done in the





An observer reading a seismograph record. The chart at the right shows how violent shocks may clog the tape, leaving a clear record of only the minor preliminary or "trigger" quake

Earthquake Danger Zones

By R. DeWitt Miller

town of Compton, located between Los Angeles and the coast. The seismograph, however, placed the epicenter of the quake in the Pacific Ocean off Newport Beach. Although Newport is built on what is practically a sand bar, no appreciable damage was done in its vicinity.

Dr. Thomas Clements, of the geology department of the University of Southern California, recalled Fusakichi Omori and the fallen stone lanterns. He wondered if the same method might not be applied to the Southern California disaster. But Southern California is devoid of Japanese lanterns. What other free-falling objects could be found on all sides of the shaken area?

Tombstones, of course! Every section of the United States, like most other parts of the civilized world, is dotted with cemeteries. The common type of grave monument, composed of a heavy column of stone perched lightly on the surface of the ground, fulfills the seismologist's requirements as well as if it had been designed for the purpose. Every city cemetery, every country churchyard, is a ready-made earthquake observatory.

Japanese stone lanterns like this suggested the theory of columnar fall as an earthquake indicator. Right, a stone upset in a Montana cemetery

Three days after the Southern California disaster, Dr. Clements went into the stricken area—looking for overturned tombstones. Round columns gave the truest data, but square monuments were also observed. Flat stones, which could only fall in one of two directions, were disregarded.

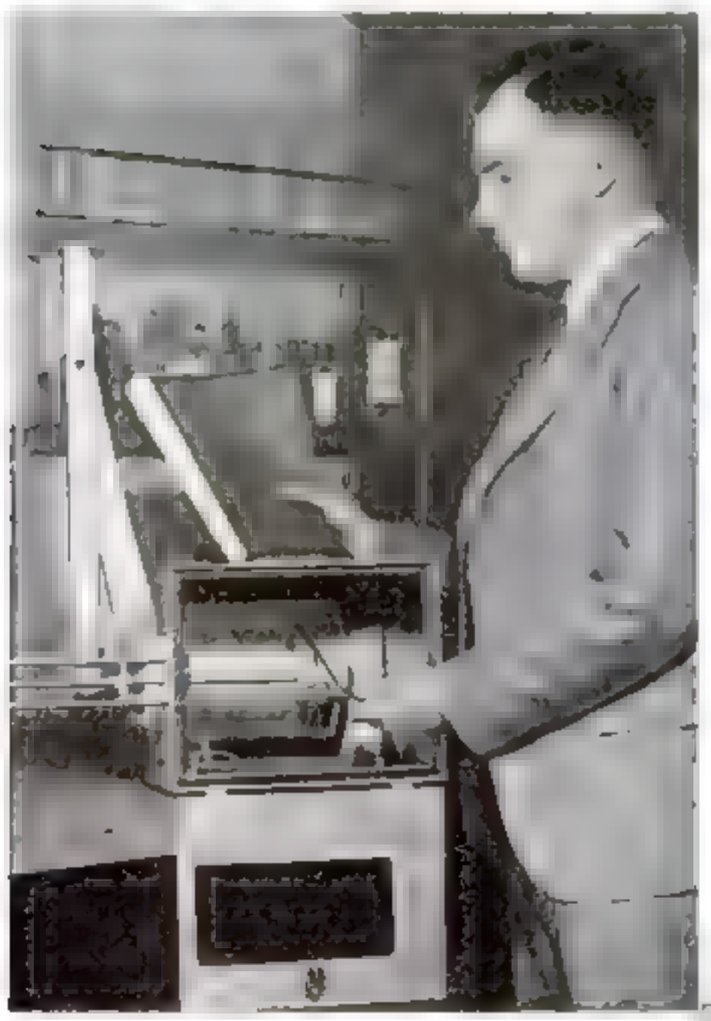
Dr. Clements visited fourteen cemeteries on all sides of the damaged area. In many graveyards, no suitable stones, for his purpose, had fallen; in others, workmen had already replaced the markers. However, five cemeteries gave over fifty free-falling stones as a basis of calculation.

Dr. Clements drew lines in the directions of fall of the stones, extending the lines, as Omori did, in both directions. Over sixty percent of the lines crossed in the Compton area. Geological maps revealed a charted fault line under the spot where the lines crossed.

The assassin was found! The fault line under the Compton area was marked forever as a potential destroyer. Why had the seismograph placed the center of the quake in the Newport channel? Dr. Clements explains it as follows:

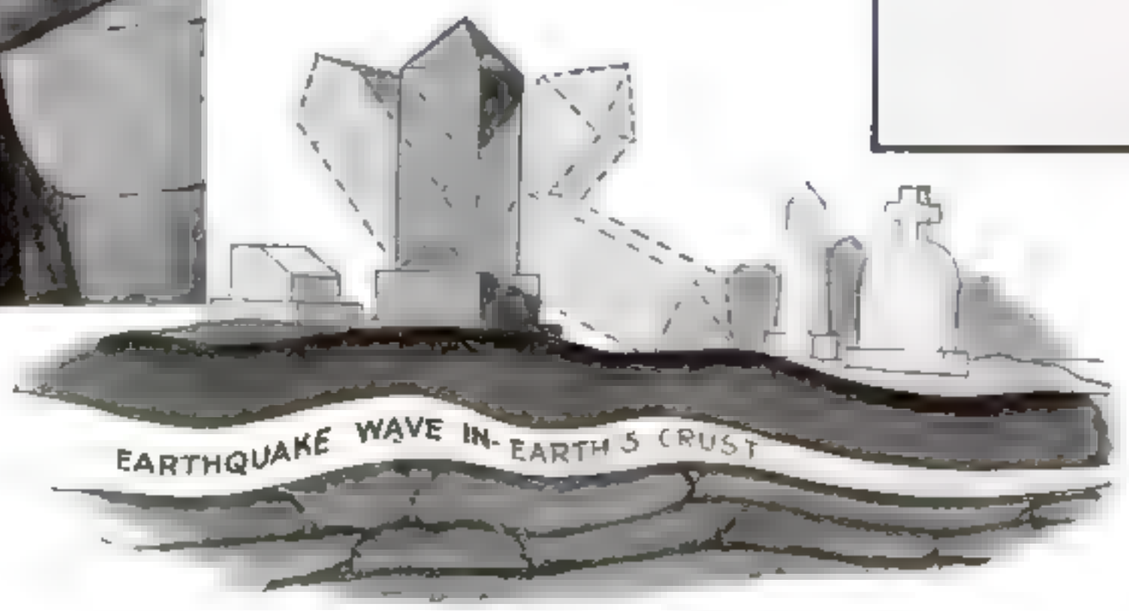
"Destructive earthquakes are often set off by some minor shock which acts as a trigger and releases the slip along the major fault. This 'trigger

(Continued on page 122)



TINY SEISMOGRAPH
Edward C. Robinson, seismologist of the U.S. Coast and Geodetic Survey, with a small seismograph of the type being installed in a nation-wide network

Map of the 1933 California earthquake area, showing how fallen tombstones pointed to Compton, the scene of the greatest damage, as the epicenter of the disturbance, while seismographs placed it at a point in the ocean off Newport Beach, thirty miles away, which was little damaged



The drawing at left shows how a gravestone will rock and fall in line with an earthquake wave

PLASTICS ARE NOW USED IN RAINCOATS

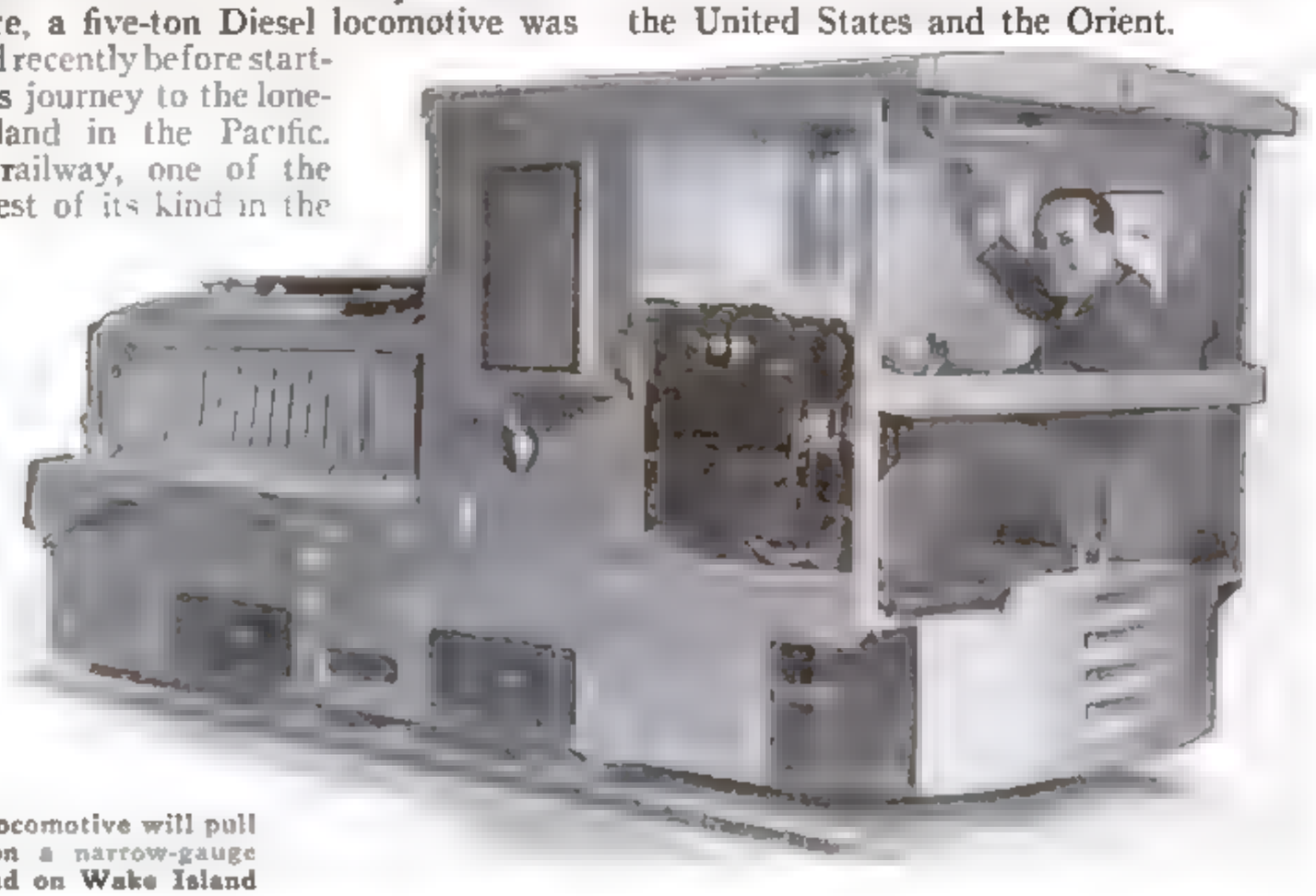
MADE by coating fabric with a synthetic resin, a new material is said to possess many advantages for the manufacture of raincoats. Oil, salt, water, and alcohol have no effect on the material, which can be washed and ironed without damage. A man-size coat weighs only twenty-two ounces, and can be folded to fit in a cylindrical container, convenient for carrying as shown by the man in the photograph at the right.

YEAR IS ON THE SQUARE

FOR the first time since 1849, Dr. D. P. LeGalley, a physicist, has figured out, the numerals of this year are a perfect square.

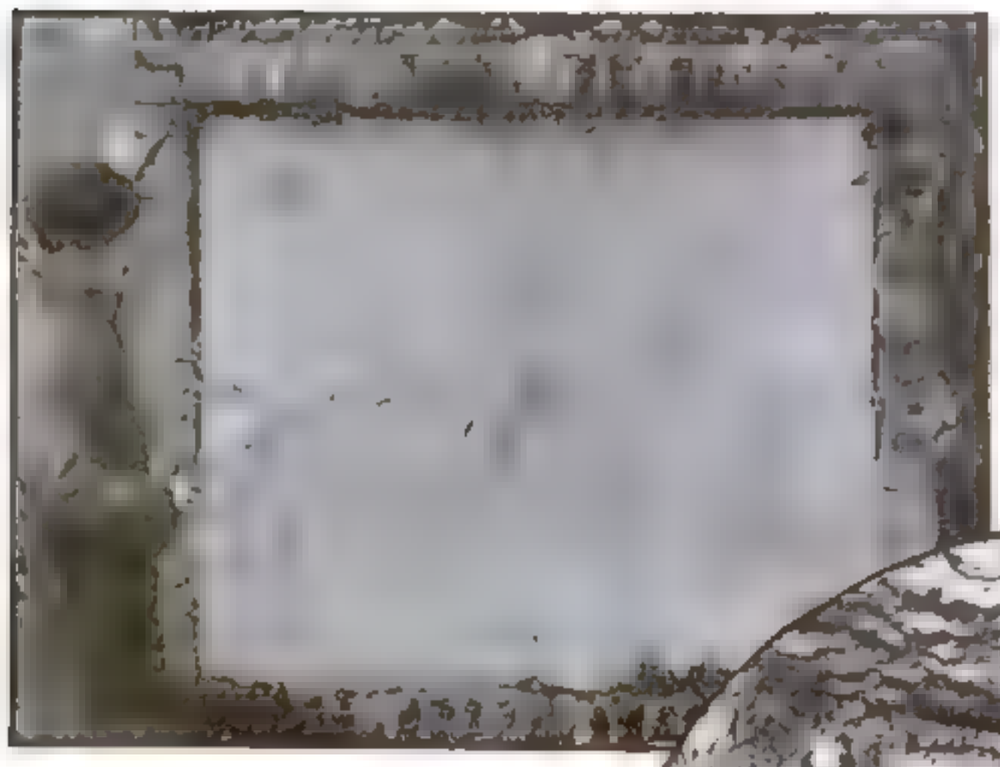
DIESEL TO RUN ON WAKE ISLAND LINE

DESTINED to haul supplies and personnel over a 2,000-foot narrow-gauge railway on the Wake Island base of the Pan American Airways Oriental service, a five-ton Diesel locomotive was tested recently before starting its journey to the lonely island in the Pacific. The railway, one of the shortest of its kind in the world, will be laid across a coral bed to connect two sections of the island, on which a prefabricated hotel is being erected to accommodate air travelers between the United States and the Orient.

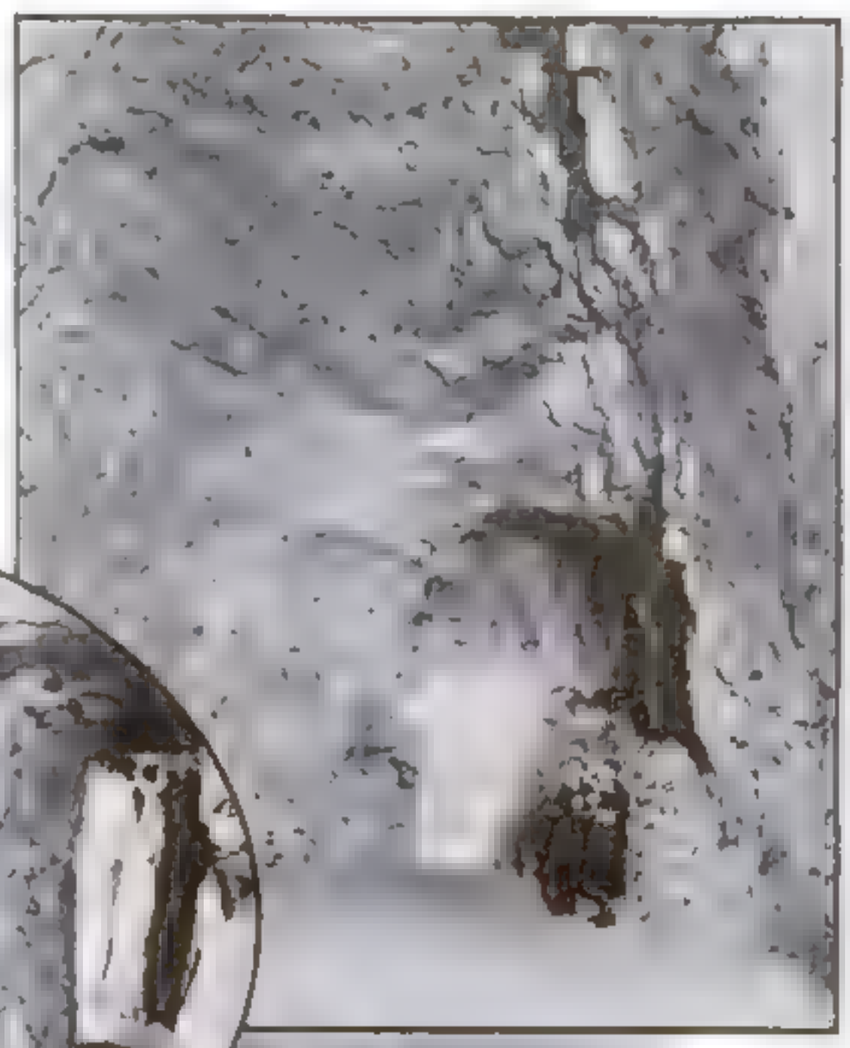


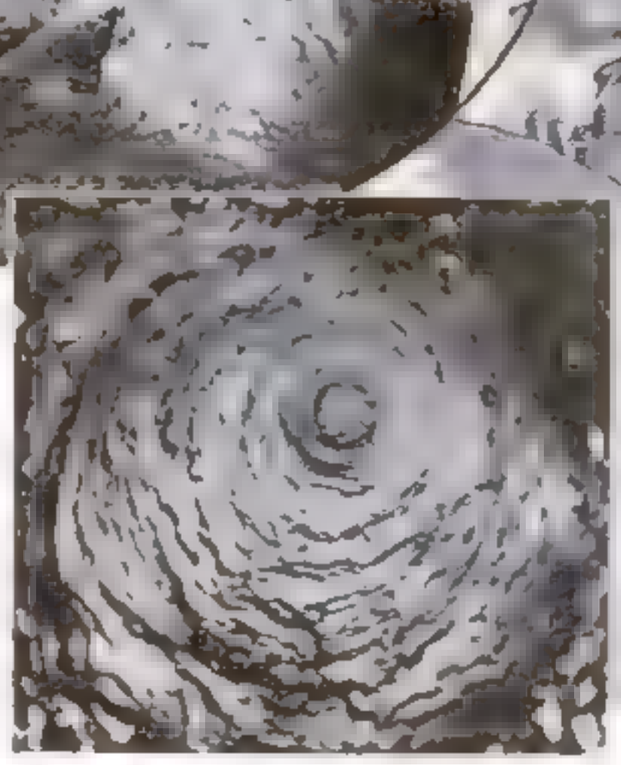
This locomotive will pull cars on a narrow-gauge railroad on Wake Island

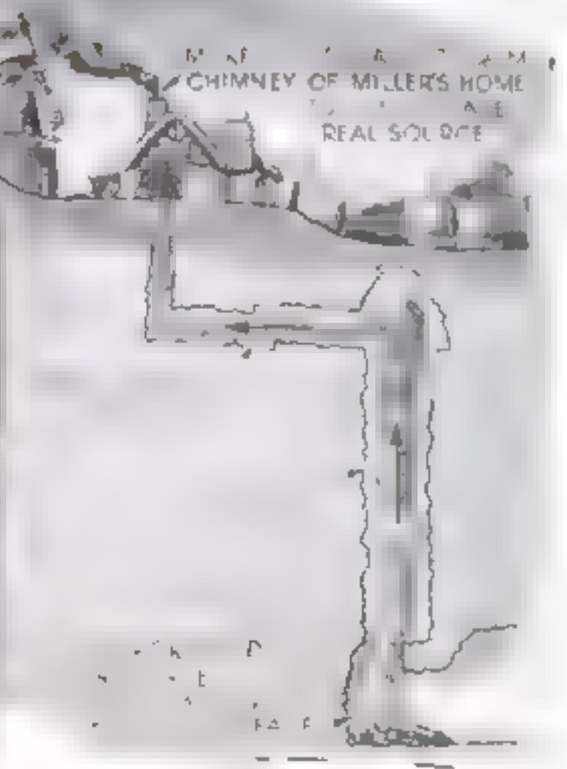
VAST UNDERGROUND HIDING PLACE UNEARTHED IN FRANCE



At the left is a map of the subterranean city recently discovered near Amiens, France. One of the largest rooms is pictured at the right, showing the vast proportions of the ancient place of refuge. The maze of halls and corridors includes three "chapels" set off by massive pillars which can be seen in the photograph reproduced below



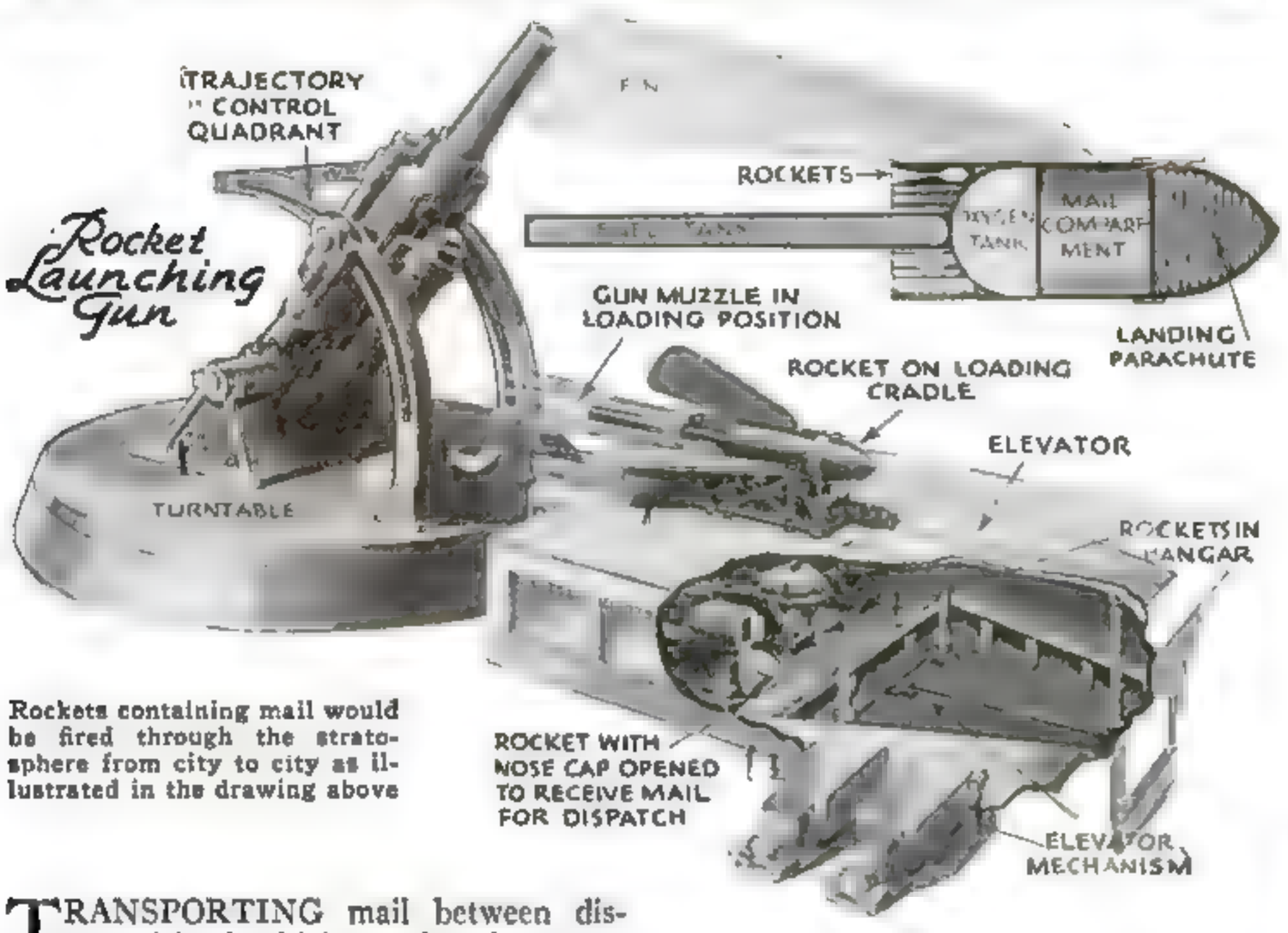




WITH 7,500 feet of subterranean chambers and passageways already excavated, and its full extent still undetermined, an amazing underground city near Amiens, France, ranks as the greatest of its kind in Europe. Since the third century it is said to have served as a refuge for the neighboring population during repeated invasions of enemy hordes. Its existence had long been forgotten, however, until about thirty years ago a Catholic priest, Abbé Denicourt, found old documents describing a city beneath the ground and rediscovered the site. To date, explorers have found more than 300 interconnected grottoes, many large enough to be used as assembly halls, hewed from the chalk 100 feet below the surface. Searching for the outlets of huge chimneys that led upward from underground fireplaces, diggers unearthed a remarkable example of ancient camouflage. The flues led through horizontal ducts to the chimneys in the homes of two millers living on the hill above, which vented the smoke without betraying the whereabouts of the refugees. In the eighteenth century, records show the cavern was used as a hiding place by salt smugglers and, at other times, it has been a haven of safety for tax evaders and political refugees.

Looking up one of the chimneys. Drawing shows how they were camouflaged

Big Guns May Speed Mail Rockets



Rockets containing mail would be fired through the stratosphere from city to city as illustrated in the drawing above

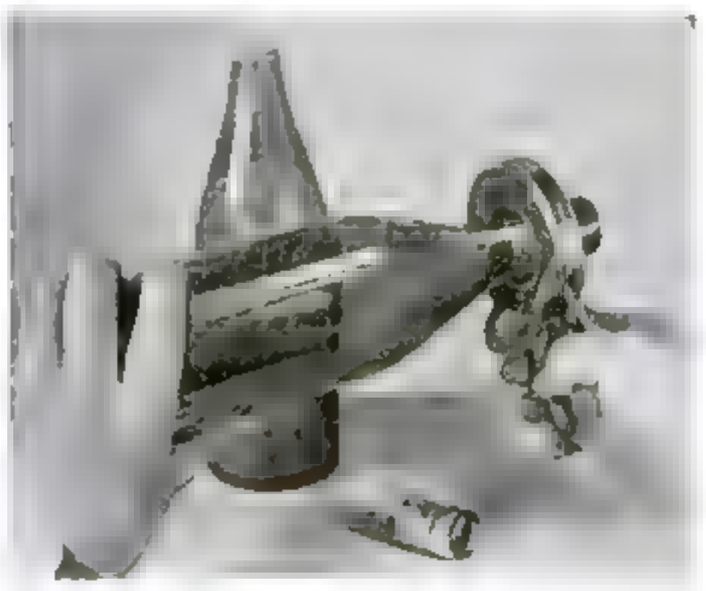
TRANSPORTING mail between distant cities by high-speed rockets may soon be brought nearer realization through a plan proposed by Louis Damblanc, noted French aviation engineer. His scheme consists of firing a rocket from a gun, which might be operated by compressed air or powder. It would boost the projectile to an altitude of several miles above the earth. At this point a timing mechanism would ignite its fuel—a mixture of liquid oxygen and gasoline, for example—and the rocket would proceed under its own power. Because of the diminished resistance encountered in the rarefied air of the stratosphere, the fuel of the rocket would be conserved and it would attain high speed and long range. With the fuel eventually exhausted, at the end of the journey, a parachute would automatically open and lower the rocket and its contents gently to earth. The sponsor of the plan envisions the establishment of special airports and hangars set apart for the use of mail rockets. The buildings will house special loading and unloading mechanisms.

PORTABLE GREENHOUSES HAVE BUILT-IN HEATERS

MINIATURE, portable greenhouses with built-in, hot-water heating systems have been placed on the market. Different temperatures are provided in upper and lower levels, and adjustable ventilation permits hardening plants for early transplanting outdoors. A kerosene lamp, or an electric unit interchangeable with it, provides the heat.

DESTROYS OLD BOTTLES BY CUTTING OFF NECKS

AN INGENIOUS hand tool, recently introduced, is the result of regulations requiring restaurants and taverns to destroy empty liquor bottles to prevent re-use. The neck of a bottle is placed in the device and the handles are squeezed while the bottle is given a slight turn. The neck is snapped off without danger of injury from chips or jagged edges of glass.



New tool in use to destroy old liquor bottles

HANDY PUMP DRAWS OIL FROM DRUMS

With this hand pump, oil is drawn easily from a reserve can or drum

A HAND PUMP recently marketed aids motorists who keep a reserve supply of oil in a drum or large can. The pump is inserted in the cap opening of the drum, pushed down, and then twisted slightly to lock it in position. It does away with lifting of the drum to pour out a quantity of oil, and may be used for removing kerosene or other solutions from storage cans.

USE AIR RIFLES IN UNDERWATER SPORT

TARGET practice beneath the water is the novel sport of members of a French diving club. At a large Paris swimming pool, they don diving masks and plunge below the surface carrying compressed-air guns that shoot elongated steel arrows through the water at tremendous speed. Artificial fish, darting and gliding through the water at the end of strings operated from above the surface, provide moving and elusive targets for the undersea marksmen who frequent this unusual shooting gallery.

Diver with compressed-air gun and target used in underwater sport

BRITISH PLANE HAS NEW WING DESIGN

FLIGHTS of 8,000 miles, nonstop, are declared possible for England's latest type of bombing plane. A novel system of internal bracing developed by B. N. Wallis, designer of the British airship *R-100*, permits the use of unusually long and narrow wings. Modifying the present method of using the metal surface or "skin" of the wing to support part of the load, the new "spider-web" bracing employs reënforcing tubes conforming to the wing shape to bear the burden.

Stellarscope in use, and samples of illuminated maps of constellations

LABORATORIES TO YIELD MUSK AND CIVET SUPPLY

CHEMISTS are about to make perfumers independent of the musk ox and the civet cat for their supply of the organic compounds essential to the preparation of high grade perfumes, according to Dr. Wallace H. Carothers, a Du Pont chemist. "Muscone" and "civetone," synthetic essences of the animal extracts, will soon be manufactured in quantities which if obtained from the animal sources would cost $40,000 a pound. These chemicals blend and hold the various odors in a perfume.

DRILLS HOLES IN PAPER

HOLES can be cut through as many as 125 sheets of paper in a single operation by means of a new and improved perforator. The operator places a stack of paper on the base of the cutter and twists the T-shaped handle of a screw, forcing a drill through the paper.

STAR GROUPS IDENTIFIED WITH ODD INSTRUMENT

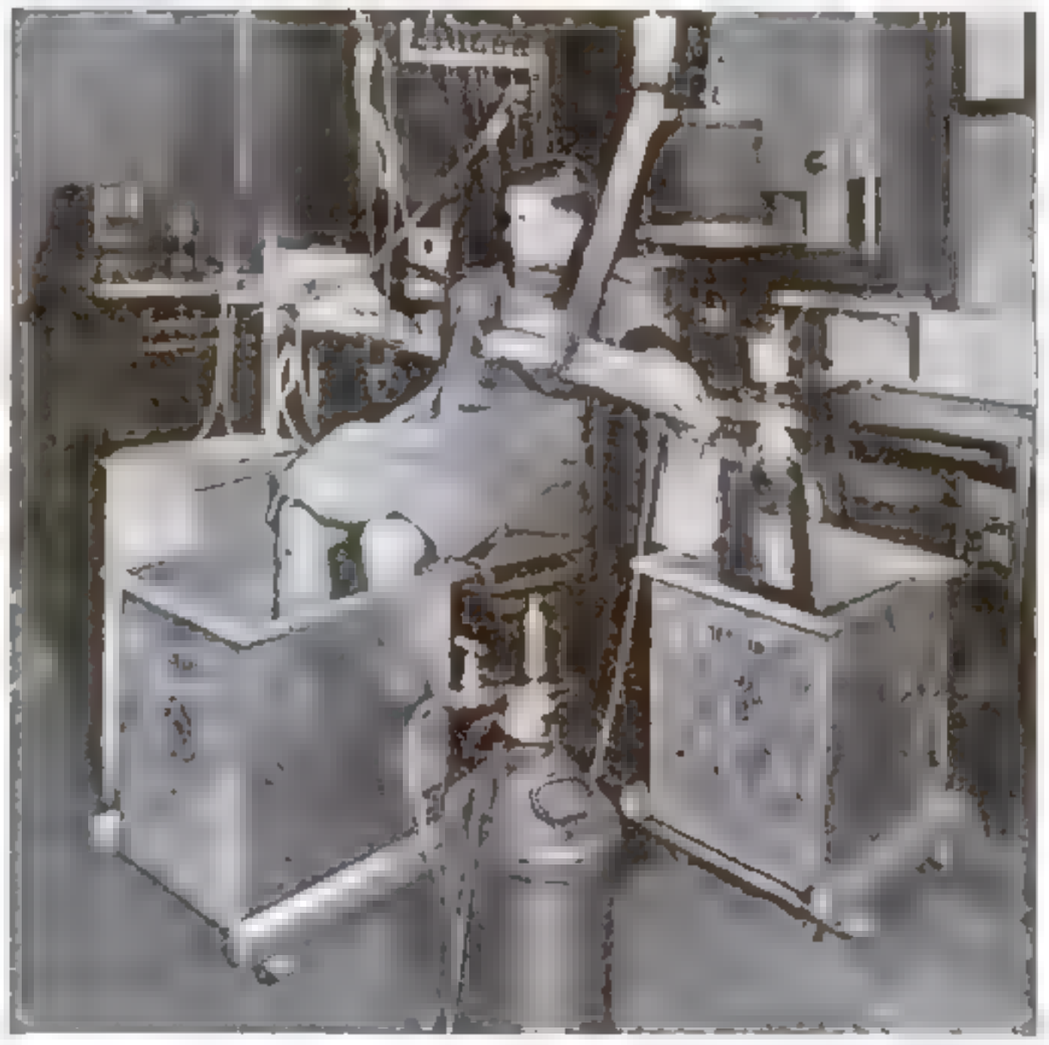
TO AID his students in learning the star constellations, Walter Bartky, associate professor of astronomy at the University of Chicago, has devised an ingenious instrument called the "stellarscope." Sighting through its eyepiece with one eye, the user sees an illuminated diagram of a star group, while with the other eye he may view the actual constellation in the night sky. A roll of film, drawn through the device, bears twenty-four star maps covering virtually every part of the heavens. These are illuminated one at a time by a self-contained flash light, and magnified by a lens in the eyepiece. Use of the stellarscope, its inventor points out, obviates the inconvenience of using ordinary star maps in the dark, and facilitates direct comparison of a diagram with the group of stars it portrays. Another suggested use is to aid pilots in night flying, particularly in planes not equipped with radio for directional signals, where it would help in navigating.

SADDLE HAS BUILT-IN CIGARETTE LIGHTER

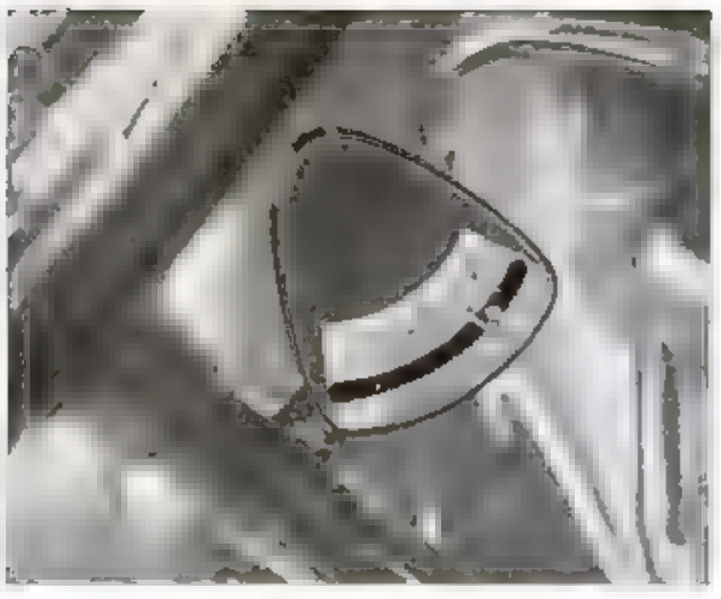
SADDLES equipped with cigarette lighters are a recent innovation in the West. When the rider wants to light up, she presses the button of a lighter which is connected to a small battery concealed in the saddle. Forest rangers believe that the idea will prevent many fires caused by burning matches.

NERVES TESTED IN WEIRD LABORATORY

SURROUNDED by a complicated maze of apparatus, London scientists undergo delicate scientific nerve tests in a weird subterranean laboratory in order to study the operation of the human sympathetic nerve system, which controls heart beat, movements of the stomach, and other involuntary bodily processes. At the laboratory entrance a red-lettered notice warns: "It is dangerous to open this door"; a sudden opening of the door might cause the subject under test to jump and suffer injury. Specially designed apparatus tests the nerve reactions of a subject to various external stimuli. The subject keeps his feet in warm water to neutralize the effect of changes in the room temperature.



A subject undergoing nerve tests. His feet are immersed in warm water to neutralize the effect of slight changes in temperature



AUTO ATTACHMENT TESTS BRAKES AT ANY TIME

PERMANENTLY clamped to the steering post of an automobile, a new brake-testing device allows a driver to check his brakes at any time. The unit is entirely self-contained and works on the principle of inertia. When the driver jams on his brakes at a stated speed, the car's momentum throws forward a small weighted pointer which indicates on a dial the approximate condition of the brakes—excellent, good, or unsafe.

RAZOR HANDLE HOLDS SPARE-BLADE SUPPLY

SPARE BLADES are stored in the handle of a novel safety razor recently placed on the market. The blades are housed in a small rectangular metal case, which is attached to a conventional type of double-edged safety razor by means of a short tubular handle.

HISTORICAL RECORDS SEALED IN VAULTS

BOOKS, maps, periodicals, letters, histories, photographs, and other pertinent material sealed in two vaults in Denver, Col., will depict the state of twentieth-century civilization to students of the twenty-second century, according to a plan developed by Dr. Duren J. H. Ward. For thirty years, Dr. Ward has been collecting, sorting, and cataloging records which portray the history, scientific achievements, customs, languages, and accomplishments, as well as the wars, crimes, and other faults of civilization up to the present day. These records are being wrapped in moisture-proof material, sealed in copper boxes, and stored in stone mausoleums. Two hundred years hence, research workers are to open the vaults, study the records, reprint or rephotograph decayed or faded material, add the history of the intervening years, and reseal the vaults for another two centuries. In this way, proponents of the plan hope to initiate a permanent and unending record of the world's civilization, knowledge, and progress. The date fixed for the first opening of the vaults is in 2131 A.D. They will be examined again in 2351 A.D., and at 200-year intervals thereafter.

Copper box containing historical data being placed in a vault. At top, Dr. D. J. H. Ward compiling records

POPULAR SCIENCE CAMERAMEN USE PLANE

WHEN speed is called for in covering a far-away news event, Jerry Fairbanks and Robert Carlisle, makers of "Popular Science of the Screen," abandon their motor truck and take to the air. The illustration shows them with the trim monoplane that helps them bring the latest wonders of science and invention to movie audiences throughout the country. Not only does it aid them to get from place to place quickly, but it also serves as a point of vantage for their cameras when aerial views are best suited for some particular subject, or when they are called upon to film a series of unusual and thrilling airplane sequences.

The speedy plane used to transport cameramen and equipment for "Popular Science of the Screen"

SAFETY ENVELOPE SHOWS MARKS OF TAMPERING

RECEIVERS of letters mailed in a safety envelope recently invented can easily detect attempts to break the seal. If a tamperer should steam or soak the envelope to open it, rows of perforations along the flap will carry the moisture through to a special ink hidden on the back, which runs and blurs, leaving an indelible tell-tale mark. The device is expected to aid in curbing mail meddling. A printed legend on the back of the envelope gives warning of the safety feature and tends to discourage tamperers before they begin their attempt to peer inside.

Rainbow Tints GIVE GREATER POWER TO YOUR

Color Filters and Stains, Readily Made at Home, Enable the Amateur To Obtain Greater Detail and Contrast When Viewing Many Types of Specimens

By MORTON C. WALLING

With the handy light and filter holder above, it is easy to add the use of color filters to your microscope work

THE amateur microscopist pursues his hobby in a world vivid with color. Many of the things he sees through his magic lenses have great beauty because of their effect on the color-sensitive mechanism of the eye. But aside from the purely spectacular effects of color as observed in specimens under the microscope, a knowledge of stains and light filters and color-sensitive photographic materials enables the microscopist to see things he otherwise would overlook, to improve the performance of his lenses, and to make better permanent records of his discoveries.

The microscope owner's first contact with color usually comes when he looks at some convenient natural object such as flower pollen, a piece of a leaf, or a sea shell. Here the color is inherent in the object. But very often a great improvement can be made by adding color where none existed before. That is where solutions of dyes, commonly known as microscopists' stains, become useful.

Dyes may be used to stain thin and very transparent specimens to make them more easily seen. Some materials, such as animal tissues, can be treated with a dye to make certain parts stand out more prominently. Thus the nuclei of cells usually are dyed to make them easy to see. Hæmatoxylin, a bluish-purple dye, is a common nuclear stain. Even when a dye affects all parts of the preparation, it frequently serves to bring out the detail by coloring denser portions more deeply than others and thus creating a contrast.

One way to stain specimens is to apply a few drops of dye with a medicine dropper and then rinse the slide in water or alcohol. Another method (upper) is to immerse the mounted specimen in a jar of stain

Stains are employed in combinations when it is desired to create the greatest possible difference in appearance between parts. For example, when animal tissue is stained with hæmatoxylin to make the cell nuclei more prominent, an additional staining with eosin, another dye that should be in every microscope laboratory, will make the cell bodies more distinct by coloring them red or pink.

Thus the microscopist, with his dyes, alters various materials and makes them more suitable for microscopic examination. The necessary stains are not costly; in fact, some of them can be found in the home medicine cabinet. A few of the more common staining materials are:

Tincture of iodine. Weaken the usual standard solution with five parts of alcohol or water. Try it on the thin membrane peeled from a piece of onion, and note that it stains the cell nuclei brown. Now try it on a piece of potato. The blue color indicates starch grains.

Mercurochrome. It can be used for animal tissues and many other objects, producing a red color.

Hæmatoxylin. This dye usually is employed in a solution that contains several other ingredients and requires considerable time to "ripen." It is best, therefore, to purchase it from a dealer in microscope supplies, or a local drug store that stocks it. Thin sections of animal and plant tissues are stained in a few minutes in hæmatoxylin solution.

Eosin. It can be dissolved in either alcohol or water. For an alcoholic stain, use about one gram of the dye to 300 cubic centimeters of ninety-five-percent alcohol. Perhaps the best all-around staining solution for the amateur is made by dissolving one part by weight of dry eosin in 200 parts of water. Eosin acts very rapidly—in thirty seconds or less with thin tissues.

Methylene blue. This dye is used in an alkaline solution, and can be purchased ready-mixed under the name of Loeffler's methylene blue solution. To mix the stain yourself, make a saturated solution of the dry methylene blue in alcohol. Mix thirty cubic centimeters of this with 100 cubic centimeters of distilled water to which have been added two drops of ten-percent potassium hydroxide solution. Methylene blue is useful for coloring a great variety of objects. It is a good bacteria stain. To color bacteria in milk or buttermilk, smear a drop of the material on a clean slide and let it dry. Let a drop of alcohol fall on it, and touch a lighted match to the alcohol. This fixes the bacteria—kills them and preserves their form. Now drop some Loeffler's

Microscope

solution on the smear, let it act for a few seconds, and rinse in water. If the stain appears too deep, you can wash some of it out with alcohol. Milk contains bacteria large enough to be seen clearly at 400 or 500-diameters magnification, with a microscope having good lenses.

These are but a few of the many stains the microscopist can use. Some of the staining methods employed for bringing out certain details of animal tissues and the like are time-consuming and involved. If you are interested in them, consult a standard text book on microscopy. Very often, amateur staining requirements can be met with the simplest of coloring materials. The various dyes sold for coloring clothing are worth trying. Even water colors from a child's paint box can be used sometimes.

While the microscopist often adds color to the object he wishes to see, he frequently subtracts color from the light with which he illuminates it. Ordinary daylight contains all the colors of the rainbow merged to produce white light. Whenever you remove some of these colors, you leave others that affect your eye.

The microscopist controls the color of the light entering his lenses by the use of filters made of colored glass, gelatin or cellophane, or even bottles containing colored water. And by this simple little trick he can work seeming wonders.

You have, for instance, a slide containing the carefully-mounted schnozzle end of a honeybee. This insect's anterior equipment appears yellowish in color when inspected under white light. Now place a sheet of blue glass or gelatin between the microscope mirror and the light source, and you find that the thick mandibles or jaws of the insect become less transparent, while the fuzzy tongue and other delicate parts stand out more prominently.

What happens is this: The blue filter absorbs most of the yellow light that otherwise would have reached the slide. The bee-mouth parts absorb the blue light and, since there is no yellow light for them to transmit, appear black to the eye.

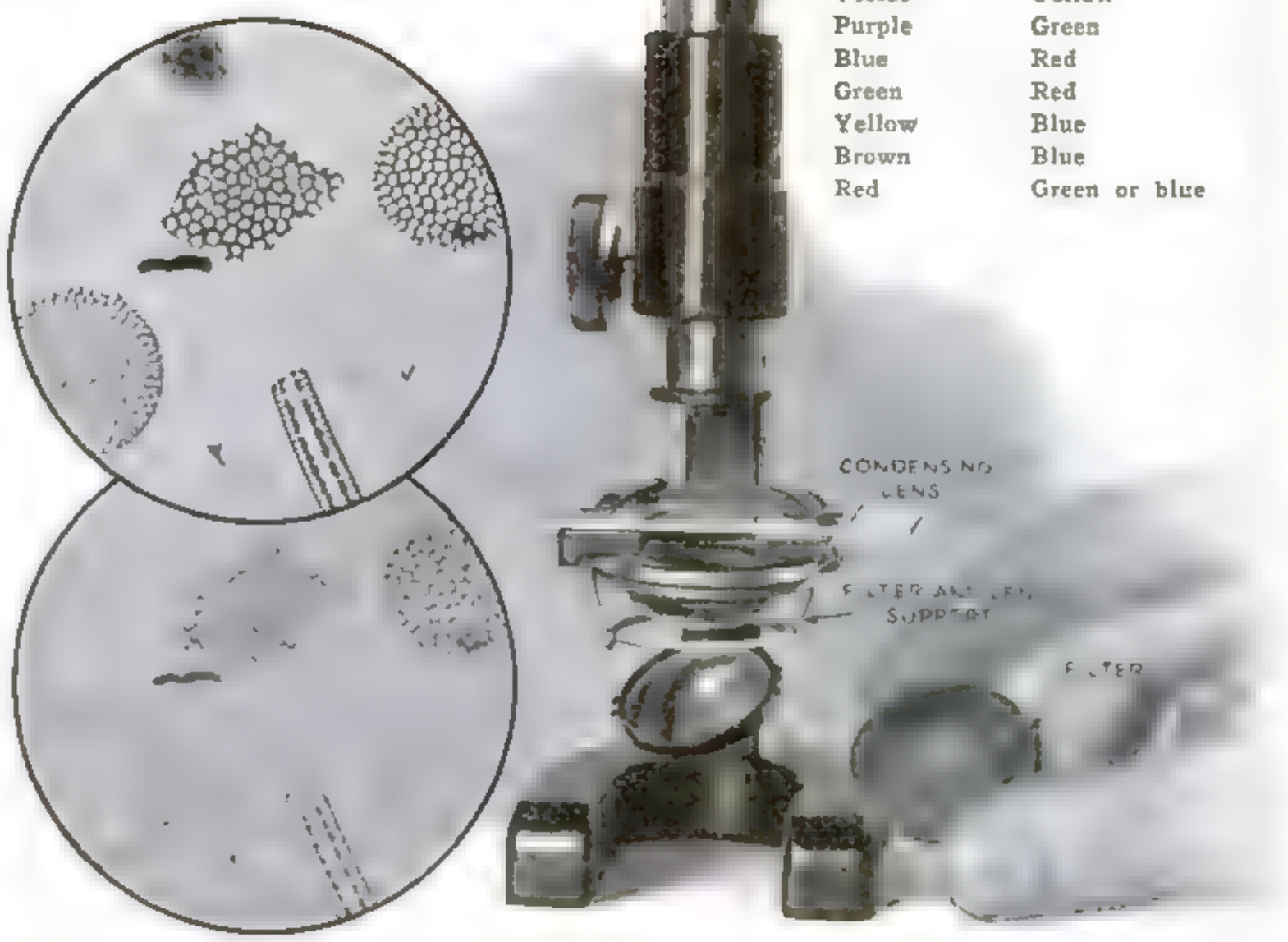
Now, if you had used a red, yellow, or orange filter instead of a blue one, the thicker parts of the specimen would become more transparent, and the delicate hairs and other finer details would fade out a bit.

By selecting filters of a color that will absorb the natural color of the object, you can make it appear darker to the eye. This frequently is useful when faintly stained preparations are being viewed. Various colors in the object require, of course, filters of different colors, when it is desired to increase contrast.

By selecting the proper filter, you can emphasize certain details of a specimen containing several colors. Thus, when examining a section of tissue having cells with blue nuclei and red bodies, you can make the nucleus of each cell appear darker and the rest of the tissue lighter by using a red filter.

Filters light-blue in color are used by many microscopists for transforming incandescent electric light into light that is very close to daylight in quality. This makes it possible to judge colors of the specimens more correctly, and also tends to lessen eye fatigue. Glass flasks or flat-walled bottles containing solutions of copper sulphate or other coloring materials that give a blue tint to the water have been used widely. However, the more convenient glass or gelatin sheet filter is replacing the clumsy bottle in many laboratories. Some microscopists prefer, for long study at the microscope, a light-green filter to lessen eye fatigue.

Another important function of color filters is to improve the quality of microscope lenses. When an optician makes a lens, he eliminates, as far as possible, inherent defects or aberrations. Two of these, chromatic *(Continued on page 115)*



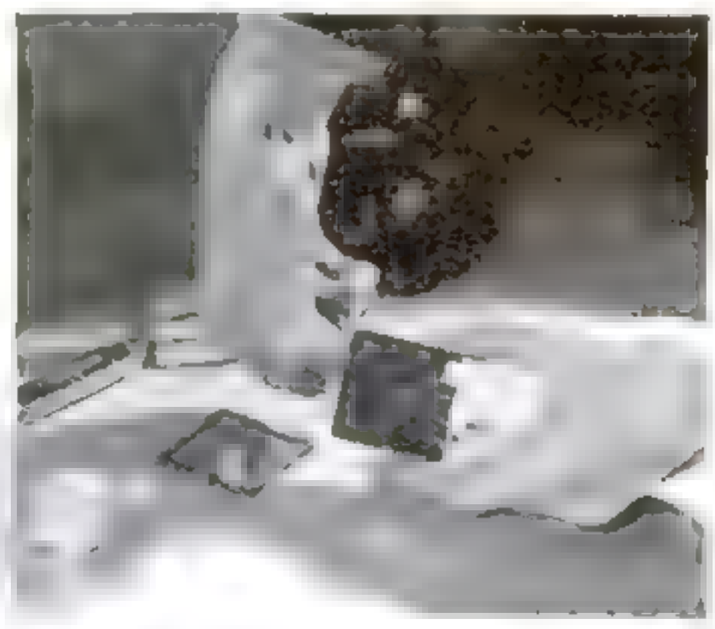
TO GET COLOR CONTRASTS

OBJECT	*FILTER*
Violet	Yellow
Purple	Green
Blue	Red
Green	Red
Yellow	Blue
Brown	Blue
Red	Green or blue

COLOR FILTERS SHARPEN IMAGE. The lower photomicrograph of diatoms was made with white light using a microscope equipped with achromatic lenses. The upper view was obtained with the same equipment and specimens by using green light produced by filters

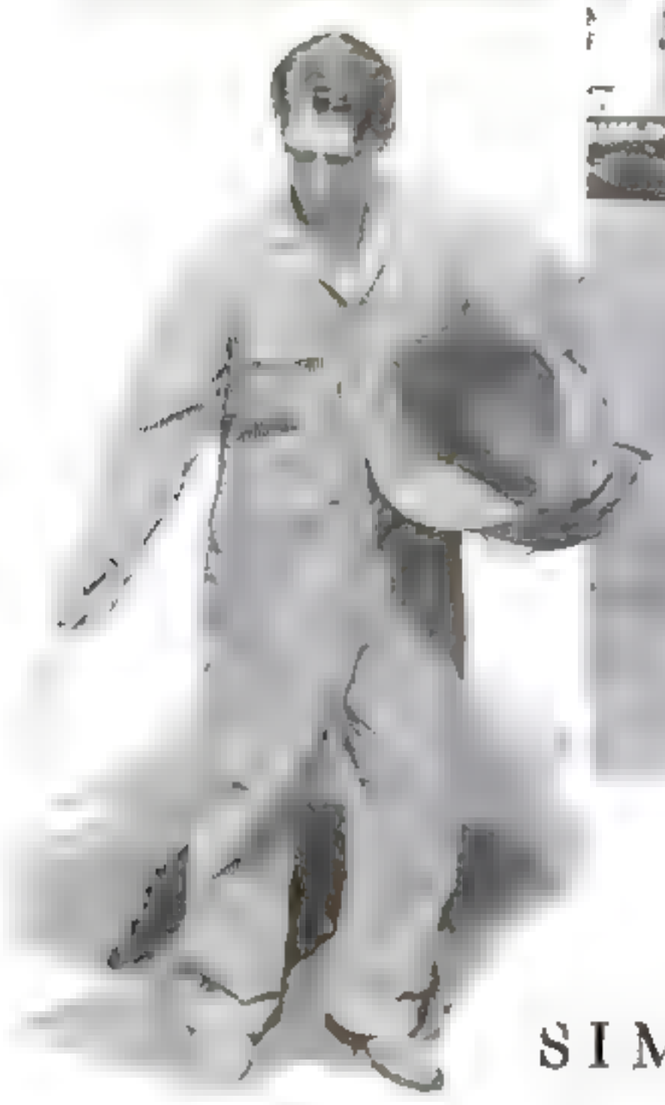
Color-Filter Holder Is Easy To Make

IT IS a simple matter to make an adjustable filter holder that can be set on the table or attached to the lamp used as a light source. A convenient size is two by two inches. Cut two pieces of glass to this size. Wash and dry thoroughly. Then sandwich a sheet of filter material between the glass pieces and bind the edges with lantern-slide or adhesive tape. If the microscope has a substage filter holder, a suitable filter can be made by cutting a disk of uncolored celluloid or equivalent to fit the holder. Now cut a disk of the same size from the filter material. Put the two disks together and bind with Scotch tape.



Binding a filter holder with transparent tape. On the table is one bound with lantern-slide tape. The adjustable holder (left) consists of a snap clothespin fastened to a U-shaped copper channel, a wooden dowel pin, and a base

In sowing a new lawn by hand, it is best to walk backward and distribute the seed by shaking the half-closed hand vigorously, as shown below. Do not sow in wind



A mechanical spreader is being used below to distribute seed and fertilizer over an established lawn. This method is also good for new lawns

Fertilizer should be washed into the lawn by sprinkling plentifully with water. Cotton-fed steer manure is best, and should be spread lightly and evenly

SIMPLE RULES THAT WILL HELP YOU TO

Beautify Your Lawn

To eradicate fungus growths and pests, use a chemical solution with a hose sprayer

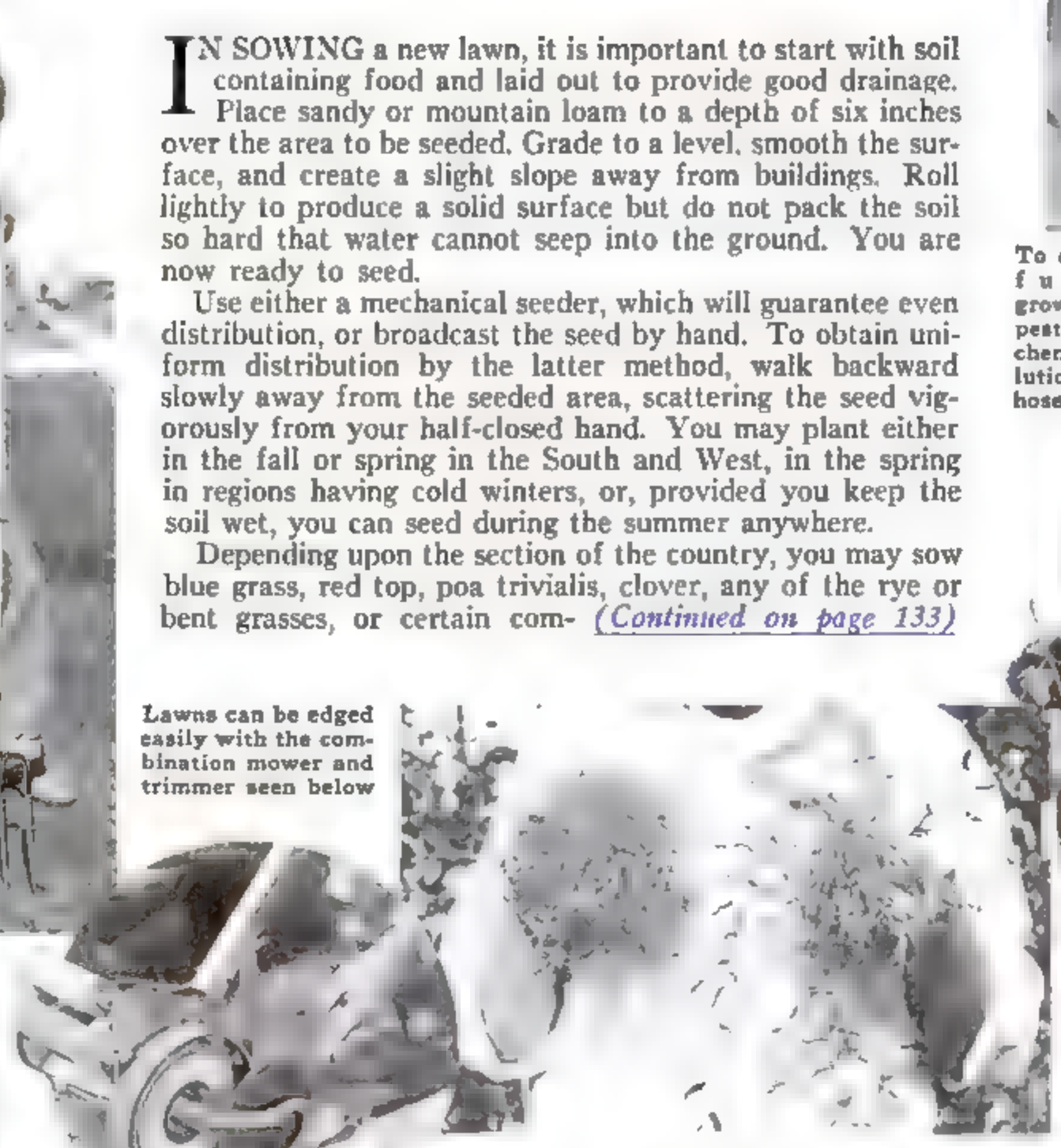
When sulphur trioxide is used to cure brown patch, the soil should first be punctured with a fork, as above. The chemical, mixed with fertilizer, is sprinkled from a scoop or shovel. The fork holes allow water to wash it down

IN SOWING a new lawn, it is important to start with soil containing food and laid out to provide good drainage. Place sandy or mountain loam to a depth of six inches over the area to be seeded. Grade to a level, smooth the surface, and create a slight slope away from buildings. Roll lightly to produce a solid surface but do not pack the soil so hard that water cannot seep into the ground. You are now ready to seed.

Use either a mechanical seeder, which will guarantee even distribution, or broadcast the seed by hand. To obtain uniform distribution by the latter method, walk backward slowly away from the seeded area, scattering the seed vigorously from your half-closed hand. You may plant either in the fall or spring in the South and West, in the spring in regions having cold winters, or, provided you keep the soil wet, you can seed during the summer anywhere.

Depending upon the section of the country, you may sow blue grass, red top, poa trivialis, clover, any of the rye or bent grasses, or certain com- *(Continued on page 133)*

Lawns can be edged easily with the combination mower and trimmer seen below



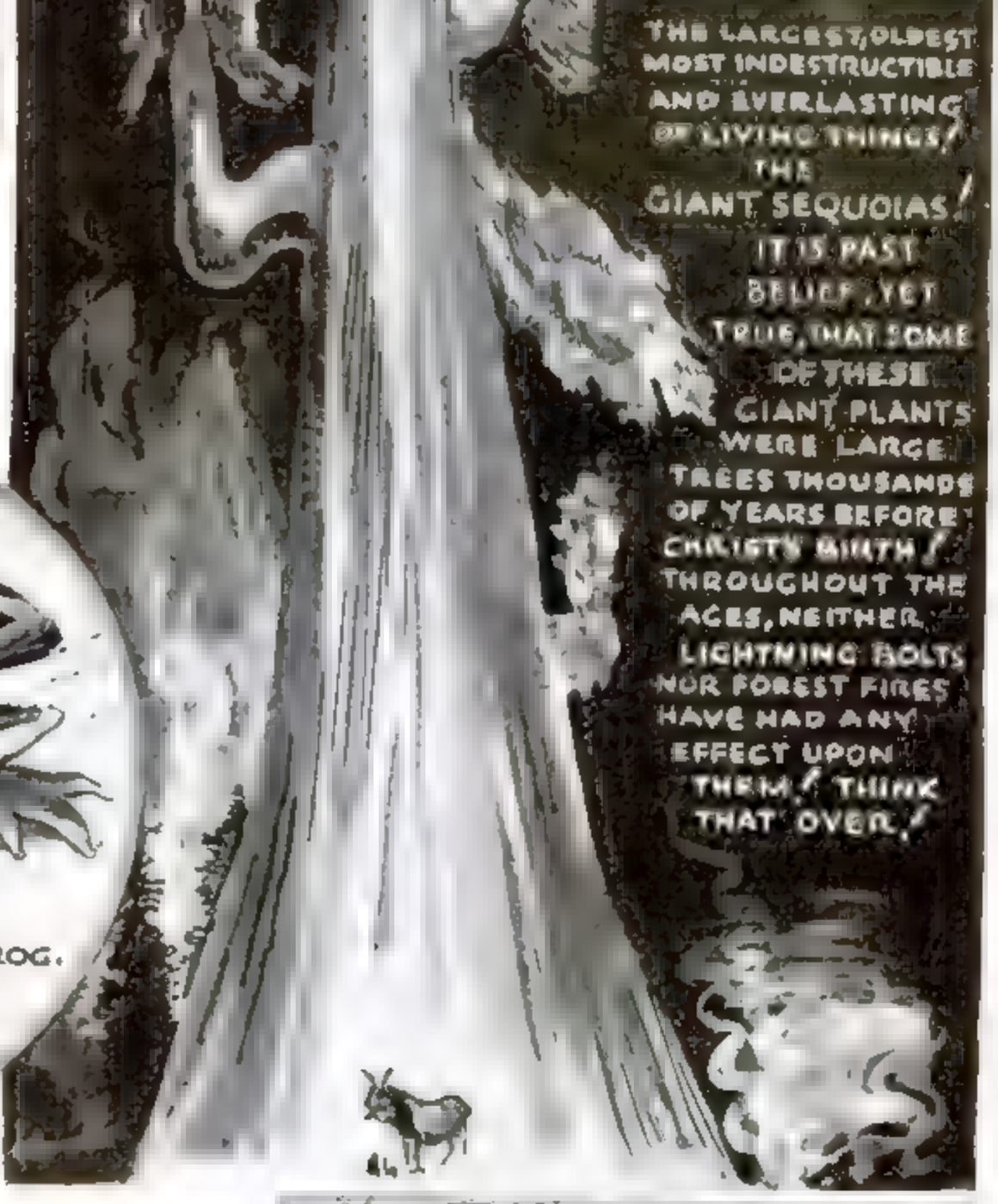
Crab grass (left) and devil grass, two of the worst enemies of a lawn. Once started, they spread rapidly and are best eliminated by intensive early weeding

Peat moss, imported from Europe in 150-pound bales, may be mixed in the soil or spread on young grass to keep the roots moist

Un-Natural History

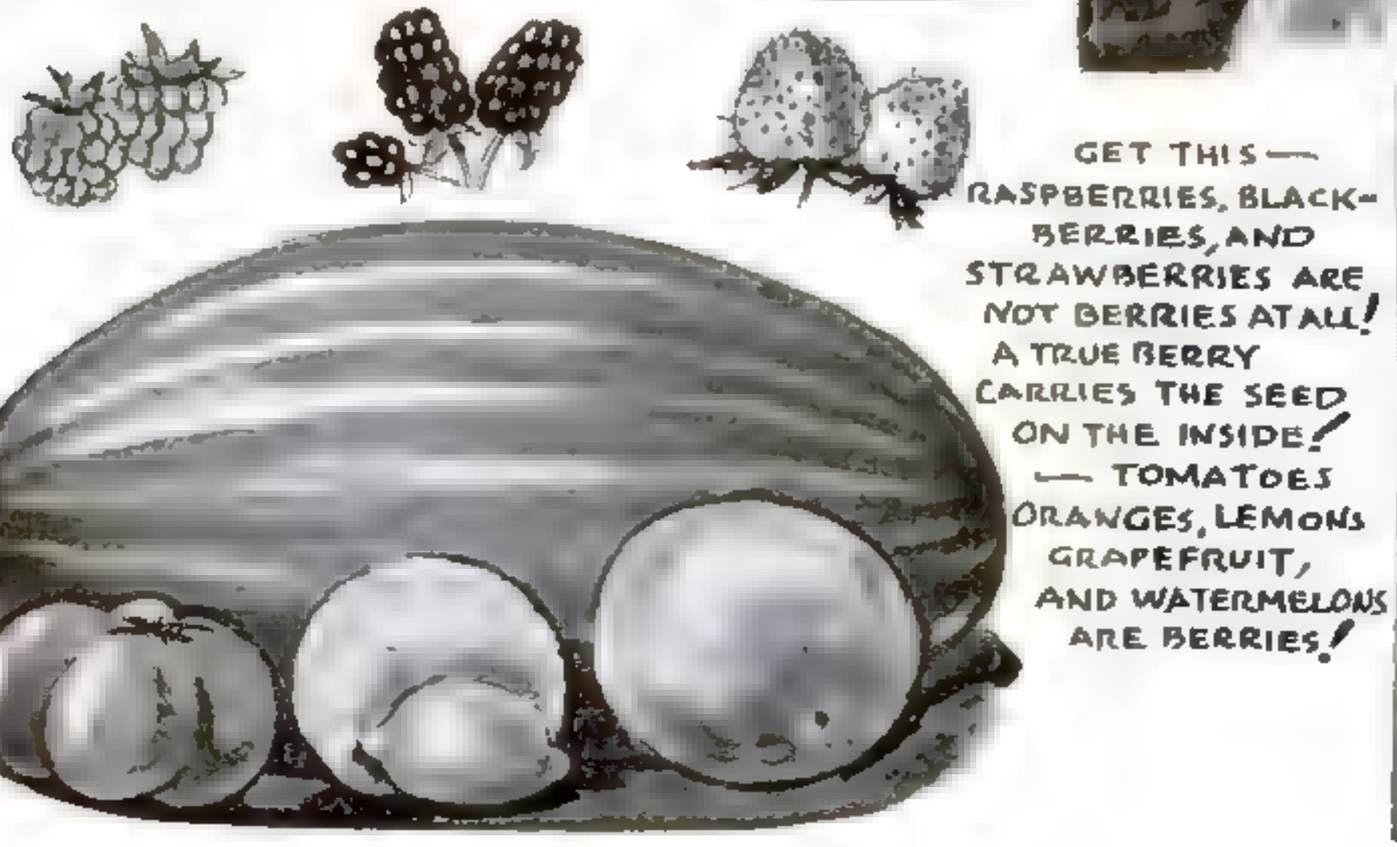
By GUS MAGER

NEW-BORN OPOSSUMS ARE SO TINY THAT 50 OF THEM WOULD SCARCELY FILL YOUR GREAT GRANDAD'S GOLD-INLAID SNUFFBOX!



THE HUMMING BIRD IS THE ONLY LAND BIRD IN THE WORLD THAT CAN FLY BACKWARD!

THE BRAZILIAN HORNED FROG. THIS MONSTROSITY BARKS AND BITES LIKE A DOG!

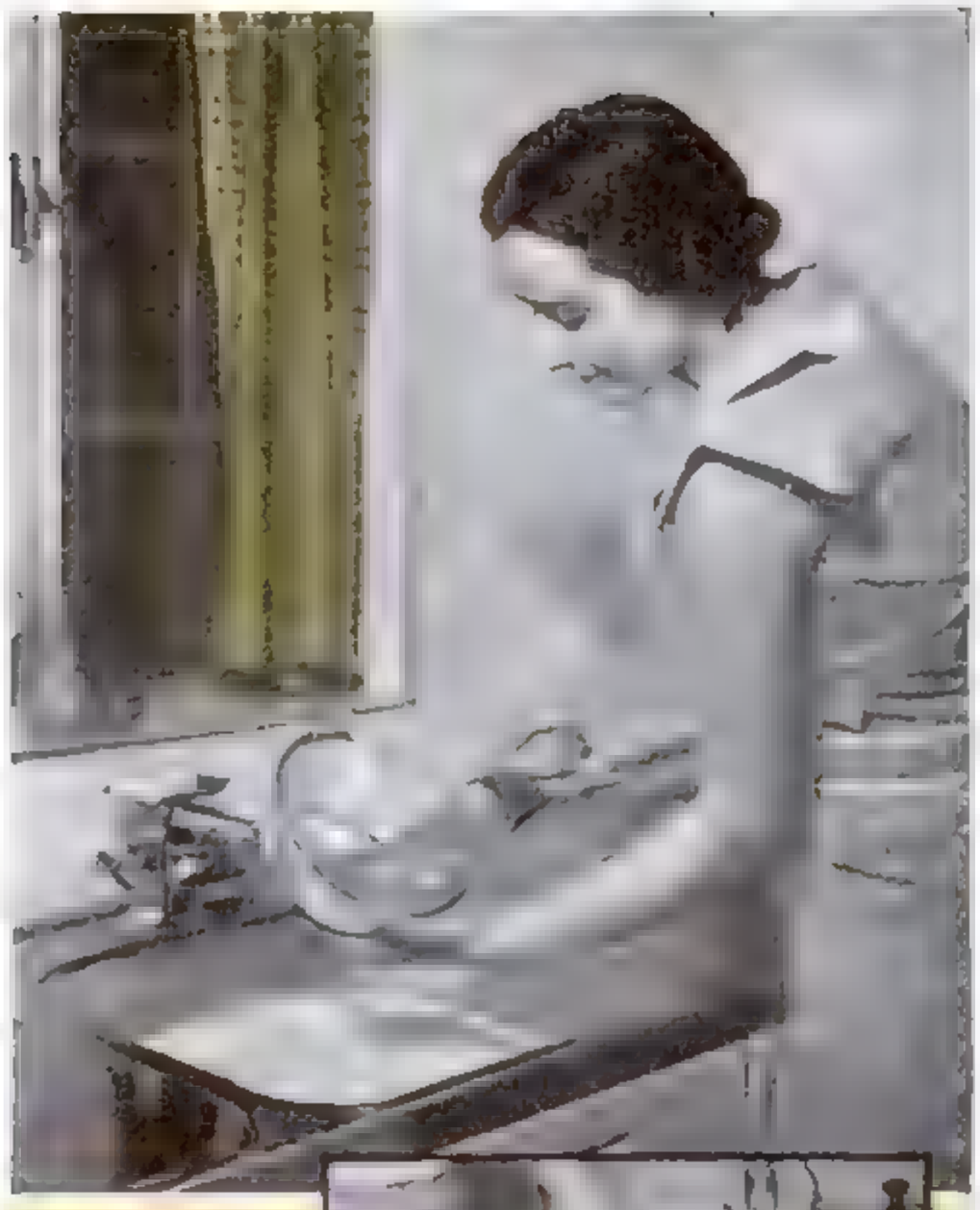


GET THIS — RASPBERRIES, BLACK-BERRIES, AND STRAWBERRIES ARE NOT BERRIES AT ALL! A TRUE BERRY CARRIES THE SEED ON THE INSIDE! — TOMATOES ORANGES, LEMONS GRAPEFRUIT, AND WATERMELONS ARE BERRIES!

WHEN we call something "unnatural" we merely mean that it doesn't follow the usual pattern. In the course of countless experiments to adapt some of her children to unusual conditions of climate or environment, nature has turned out some freakish-looking jobs that seem to violate her own rules. After looking at the examples on this page, you will at least give the old girl credit for having a lot of originality.

HOMEMAKERS' TASKS MADE EASIER BY NEW

Household Utilities



GLASS COOKING WARE FOR USE OVER FLAME

Fresh from the research laboratory comes this latest aid for the housewife—a line of glass cooking ware that can be placed directly over the cooking flame. The material is lighter and more heat-resistant than that of oven glassware. Detachable handles are used with pans

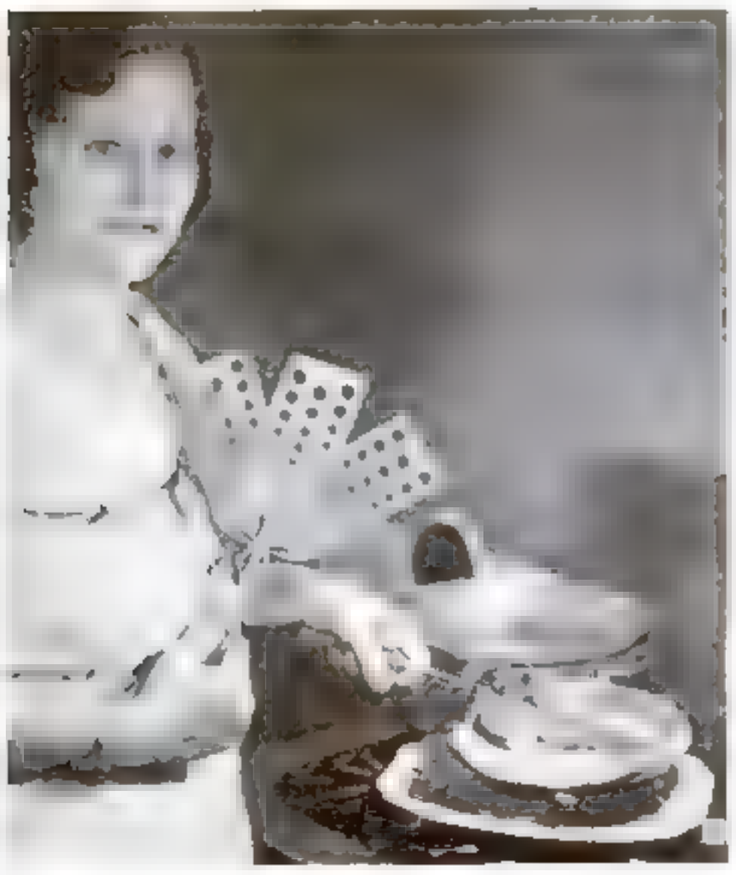
MUSICAL ALARM CLOCK

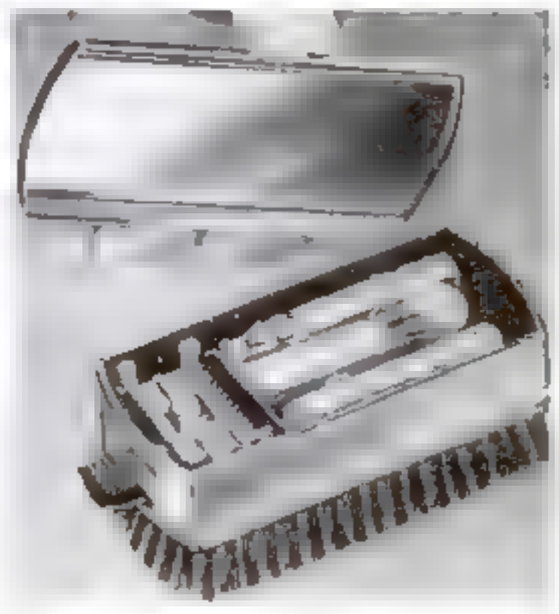
The notes of "reveille" tinkle from this novel alarm clock at the predetermined time. If the user fails to heed this martial summons, the clock waits ten minutes, then rings vigorously

SPIGOT CAN OPENER. For use with cans containing liquid that is used over a long period of time, the can opener shown at the right provides a permanent spout. It consists of a U-shaped tube terminating in sharp points that cut through the can top. A hinged spout at one side makes pouring easy, and folds back when not in use to seal the remaining contents

COFFEE MAKER FOR TRAVELING. Tourists who are fastidious about their coffee can now prepare their own beverage in the portable, glass drip-coffee maker illustrated below. The unit, with its alcohol heater is contained in a cylindrical leather case; another holds canisters for coffee, tea bags, and sugar. The outfit should also prove handy for picnics and sports

TOILET KIT IN HAIRBRUSH. Hidden in the handle of the hairbrush below is a complete outfit for shaving and caring for the hair—safety razor, shaving brush, soap, mirror, and comb



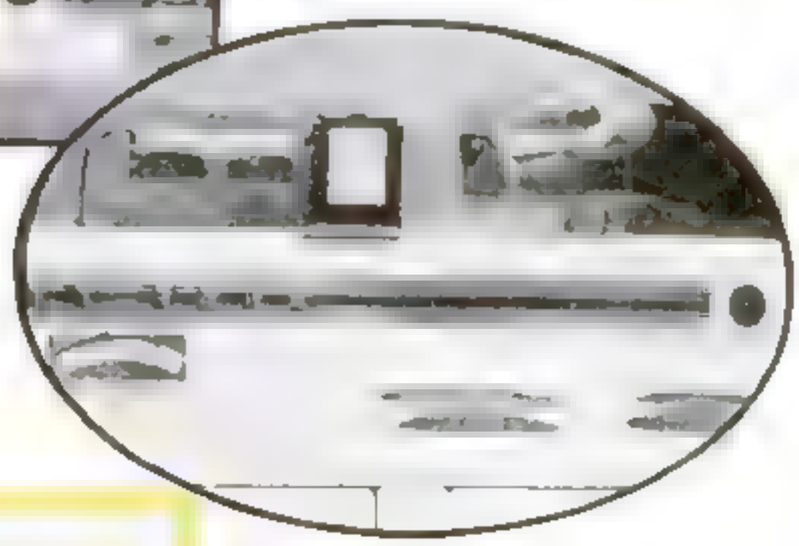


THREE-PADDLE LIFT. Omelettes, griddle cakes, and similar foods can be handled easily with this triple lift. It is slipped under the food with the leaves together; pressure on a trigger causes them to spring out like a fan

PAPER-ROLL DUST MOP. A roll of specially prepared paper, as soft as cheesecloth and chemically treated to make it pick up dirt, is the cleaning surface of this novel dust mop. When the outside of the roll becomes dirty, it is torn off to expose a clean surface. Rolls are inexpensive

RANGE HAS OVEN LIGHTS

When either of the two ovens of a new electric range is opened, built-in lights flood the interior to show the condition of the food without the necessity of removing it. The ovens operate independently, one with automatic two-temperature control and the other with ordinary control. At left, built-in cigarette lighter



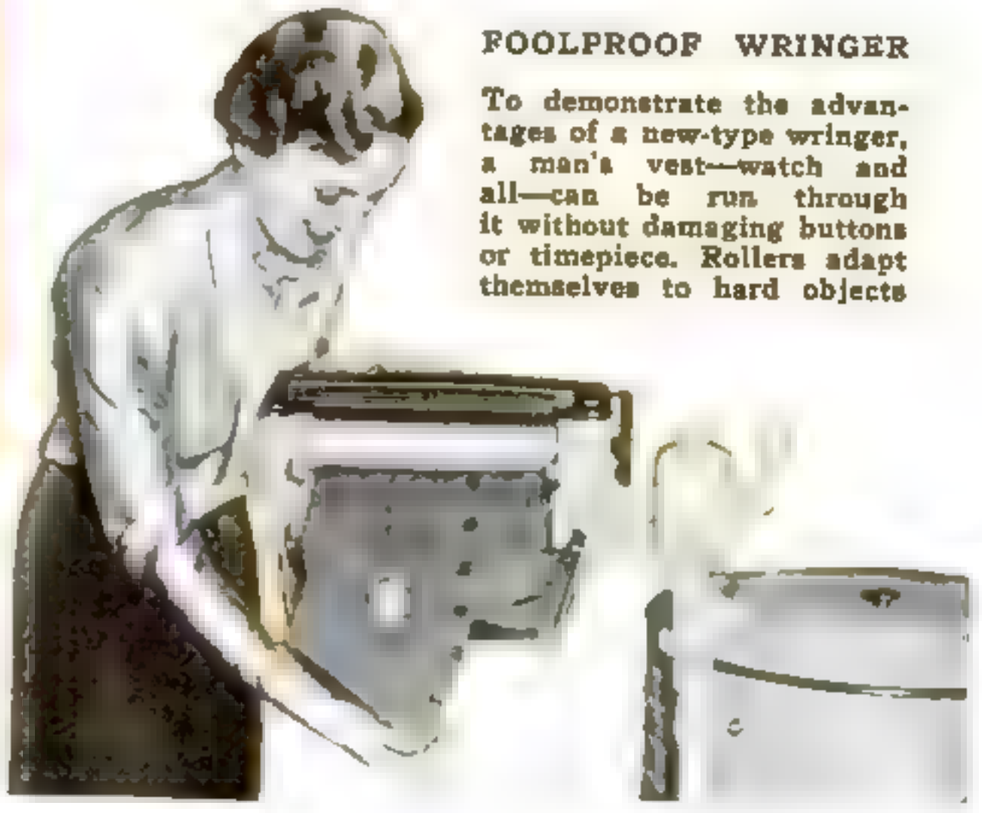
A signaling device on the backsplasher of the range times surface cooking. Two platform lights swing out to throw light on cooking pans

LAMP HAS HIDDEN LIGHT SOURCE. A disk-shaped reflector and diffusing globe take the place of the usual shade and bulb in the floor lamp pictured above. Light is distributed evenly and without glare. The adjustable brass standard has a tray for holding smoking or sewing articles

MEASURING SPOON

Seven measuring spoons are combined in the handy kitchen accessory pictured below. Graduated for both teaspoon and tablespoon measure, it is adjusted by means of a sliding thumb control. It measures liquids or powders

SECTIONAL TIE RACK. By adding extra metal crossbars, this unusual necktie holder can be made to hold any number of ties from six to sixty. The arrangement is such that each tie is always in plain view and may be removed or replaced instantly



FOOLPROOF WRINGER

To demonstrate the advantages of a new-type wringer, a man's vest—watch and all—can be run through it without damaging buttons or timepiece. Rollers adapt themselves to hard objects

Mystifying Stunts

Entertain Your Friends with These Feats of Magic, Easily Performed With Home-Laboratory Equipment

While a startled "assistant" juggles the magic hot ball, the chemical wizard transforms "water" into five liquids of different colors and kinds

By Raymond B. Wailes

AN AMATEUR chemist with a flair for showmanship can entertain his friends with absorbing tricks of chemical magic. At will he can evoke hissing gases, colored lights, strange odors, and effect seemingly miraculous transformations. Such demonstrations may be as simple or elaborate as desired.

A "chemical factory in the palm of the hand" could be the title for a parlor trick that may be performed with a minimum of preparation. When a pinch of lime and another of ammonium chloride are placed in the palm and rubbed together, ammonia gas is the result. It is a familiar experiment to a chemist, but none the less impressive to a layman. The ammonia is readily recognized by its odor.

A simple "magic powder" that changes its hue at the performer's touch is a mixture of mercuric chloride and potassium iodide, in the dry, powdered form. When the white mixture is rubbed, the small quantity of red mercuric oxide that is formed gives the whole powder a yellow color. This may be done in the palm of the hand, or the white mixture may be placed in a small pill box and shaken for a minute or so, which is sufficient to produce the surprising color scheme.

Trick matches to fool a smoker may be prepared from ordinary safety matches by coating the heads and a small part of their length with a solution of water glass (sodium silicate). The water-glass solution customarily employed for preserving eggs may be used for this purpose. Let the coating dry thoroughly. When the matches are struck on the side of the box, they puff, smoke, and sputter, but no effort can induce them to light. Trick exploding matches are made in another way, not to be tried in a home laboratory; their effect is produced by a small crystal of silver fulminate, affixed to the match with an adhesive.

Small explosions that supply effective "atmosphere" for a chemical-magic show may be produced safely with other chemicals, such as a mixture of sulphur and potassium chlorate. The quantity of the mixture used should not exceed half the size of a pea. When this is struck with a hammer, a noisy but harmless detonation results.

"Pharaoh's serpents," amusing and mystifying, may easily be produced in an amateur laboratory. These are the wriggling, snake-like forms of ash that emerge from a small pyramid of suitable chemical composition when its tip is ignited. There are several ways of preparing such compositions, which vary in effectiveness according to the relative volume of ash that they form. One standard method consists of mixing solutions of a mercury salt and a sulphocyanide, or thiocyanate, as it is sometimes called; mercuric chloride or mercuric nitrate may be used for the first, and potassium sulphocyanide or sodium sulphocyanide for the second. The heavy precipitate of mercuric sulphocyanide that results is washed, dried, and molded into small pyramids, with or without the addition of dextrin or glue water as a binder. A second method uses, for ingredients, sugar, potassium nitrate, and potassium bichromate, mixed together and molded to the desired shape. This mixture, however, produces only a limited quantity of ash and its burning qualities leave much to be desired.

A far more striking demonstration of "Pharaoh's serpents" may be given with the aid of a little laboratory apparatus and a mixture consisting of strong sulphuric acid and paranitroacetanilide. This organic chemical is a light yellow, fluffy powder. You will not be likely to find it on the shelves of a drug store, but dealers in chemicals can supply it. It is not necessary to buy more than an ounce. The grade known as technical is pure enough for your needs, although, of course, the C. P. (chemically pure) variety may be employed.

Mix the chemical with strong sulphuric acid in an evaporating dish, using plenty of the powder and adding the acid spar-

When a mixture of sulphuric acid and paranitroacetanilide is heated over a small flame, an impressive "serpent" writhes out of the dish

for the AMATEUR CHEMIST

With the simple "properties" pictured above, you can provide many hours of fun and mystery. They include the "hot ball," water-to-wine outfit, trick matches, and magic transfer fluid

ingly. You should obtain a thick paste, almost solid in consistency; a thin one will not work satisfactorily.

When all is ready for your demonstration, heat the mixture gently over a small flame until the reaction sets in. The ash erupts from the dish with a writhing movement, simulating a giant snake, and the quantity produced from a small amount of chemicals is really astonishing. Only a tablespoonful of the mixture was used to produce the spectacular effect shown in the accompanying photograph. The ash is comparatively tough, and may be picked up and tossed from hand to hand. For an indoor demonstration, it is best to open the windows during the reaction, although the odor produced is not unpleasant.

Certain chemicals evolve a surprising amount of heat when water is added to them, and you can apply this fact to an amusing bit of byplay. A hollow copper ball of the type sold by plumbing supply dealers makes a good accessory for the trick. Into it should be placed about a tablespoonful of a heat-producing mixture made in accordance with one of the formulas given in a subsequent paragraph.

At some time during your exhibition of chemical magic, add a quarter glassful of water to the contents of the ball, and stopper the hole with a machine screw. Then ask a volunteer from your audience to come forward and assist you by holding the ball, as if you planned to use it in a forthcoming demonstration. Proceed at once with another part of your program, keeping your unsuspecting "assistant" standing beside you with the ball in his hands.

Soon he will notice that the ball is getting warmer, and you may see him shifting it uneasily from hand to hand. Before long it will be downright hot. The onlookers will enjoy a laugh at the expense of the victim, as he is presently forced to deposit his embarrassing burden wherever he can find a suitable place to set it down.

For this trick, you may take your choice of several heat-producing mixtures, selecting the one whose ingredients are available. One suitable preparation may be made by mixing ninety grams of sodium acetate, ten grams of sodium hyposulphite, four grams of glycerin, and one gram of calcium chloride (a teaspoonful equals about five grams). Another good formula consists of sixty grams of iron filings, one gram of lead chloride, and one fifth of a gram of aluminum powder. A third recipe uses seventy grams of iron filings, seven grams of copper sulphate, two grams of common table salt, one gram of calcium chloride, and one gram of potassium chlorate. Any other unit of weight, of course, may be substituted for grams in these formulas, provided the ingredients are mixed in the proportions called for.

NO EXHIBITION of chemical magic is complete without some version of the classical "water-to-wine" trick. Here is an elaboration of it that produces a variety of striking color changes and other effects.

This demonstration consists of pouring a liquid, apparently water, into five seemingly empty glasses arranged in a row. As each glass is filled in its turn, the first glassful looks like water; the second, red port wine; the third, bright blue ink; the fourth, milk; and the fifth effervesces, so much like a headache potion that you may facetiously announce it will be set aside for the benefit of anyone who tries to figure out how the trick is done. Since the liquids are not what they seem, no one, of course, should be permitted to sample them.

The liquid that you pour into the glasses is really a weak solution of ferric chloride or of ferric nitrate. After either of these iron salts has been dissolved in the required amount of water, the liquid should be acidified by adding three or four cubic centimeters of strong sulphuric acid for every pint of solution. If the solution is dilute enough to be colorless, it may be poured from a decanter of clear glass. A stronger solution of the iron chemical will be somewhat yellowish in tint but may still be used if it is poured from a colored bottle that masks its color.

Only the first of the five glasses used for this stunt is actually empty. The others contain small quantities of chemicals that react with the iron-and-acid solution to produce the varied effects. As much of each chemical should be used as will escape detection at a short distance.

Glass No. 2, when prepared for this demonstration, has been rinsed with a strong solution of potassium sulphocyanide (thiocyanate); and if a few drops of the solution can be left in the bottom of the glass for good measure, without being too apparent, so much the better. Upon the addition of the iron solution, an iron thiocyanate is formed, and its red color gives the liquid the appearance of wine.

Glass No. 3 is prepared in the same way, except that the solution used is potassium ferrocyanide (yellow prussiate of potash). On reacting with the iron solution, it forms Prussian blue.

Glass No. 4 should contain several drops of a strong solution of barium chloride or barium nitrate. The milky effect obtained is due to a precipitate of white barium sulphate, produced by the sulphuric acid in the solution that is added.

Glass No. 5 is sprinkled with a thin layer of baking soda. The acid in the liquid poured upon it decomposes the chemical, liberating carbon dioxide gas and thus causing the effervescence.

Before the glasses employed in this demonstration are used again for other purposes, they *(Continued on page 129)*

Using a "magic fluid," cartoons can be easily transferred to white paper

Homemade Color Organ

PLAYS WEIRD RADIO ACCOMPANIMENT

The automatic color organ in use. It is connected to the output of a broadcast receiver

Music Is Interpreted In Vivid Hues on the Translucent Screen of This Fascinating and Easily Built Accessory

By
JOHN L. RENNICK

HERE is the latest in radio novelties—a miniature color organ. Connected to a broadcast receiver, it translates sound into color to produce an accompaniment of colored lighting for any radio program. Its built-in screen glows in dancing hues as pleasing to the eye as music is to the ear.

Unlike most large color organs, which are manually controlled by a skilled operator, this circuit is entirely automatic; the predominant pitch of the music alone determines the color. Low notes bathe the screen with a deep red, the middle register shows in varying shades of green, while a brilliant blue responds to the high notes of the flute or violin. Blended combinations of these colors give the intermediate shades.

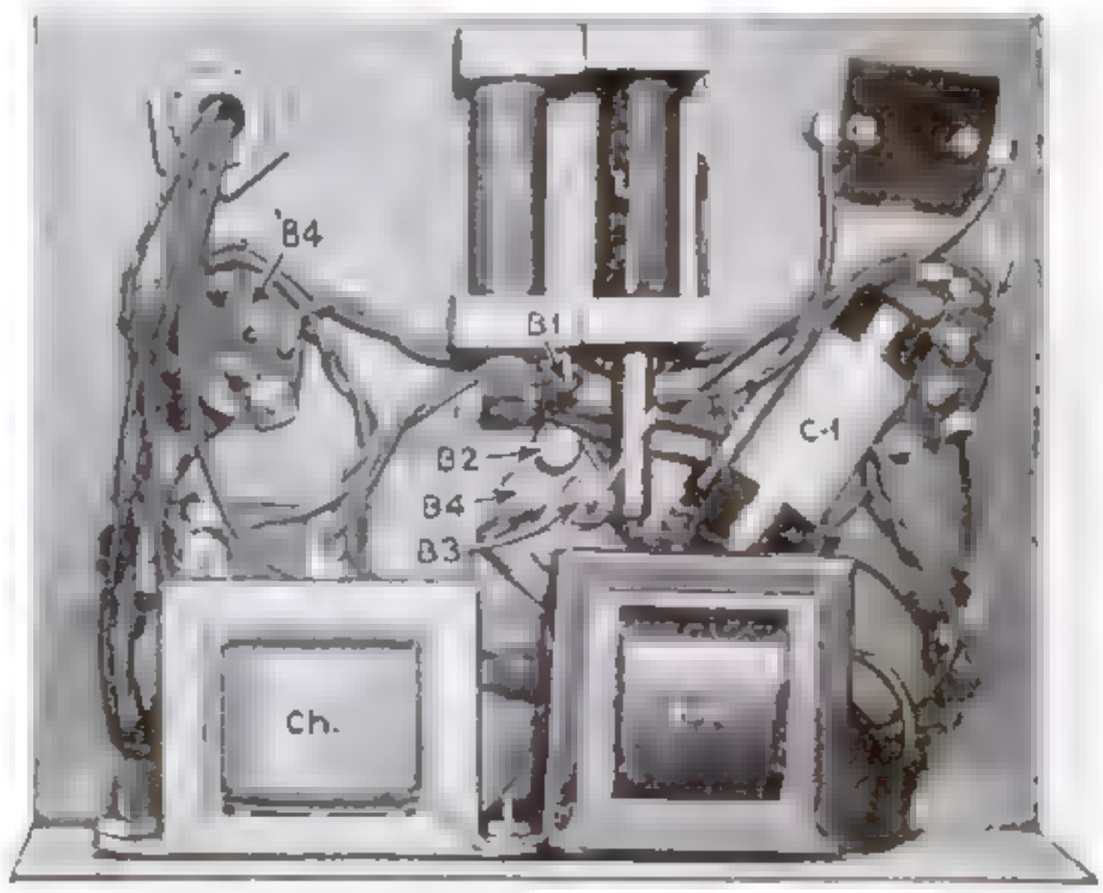
With present-day receiver tubes it is an easy matter to obtain sufficient audio-frequency power to light several miniature lamps. It only remains then to provide color screens for the lamps and to connect them in a simple frequency network designed to separate the "tones" and feed the power to the proper lamps at the proper time.

As arranged, the circuit is a compact combination of power supply, amplifier, frequency network, and optical system mounted on a steel chassis designed to fit a midget radio cabinet. It is completely self-contained. To put it in operation, it is only necessary to plug it into an alternating-current line and make the proper connections to the output of a standard receiver.

An examination of the circuit shows that the amplifier and power-supply connections are standard. The frequency network, shown at the right in the diagram, is the only unusual part of the entire circuit. It is fed through a standard speaker-coupling transformer (T_2) designed to work into an impedance of thirty ohms.

Frequencies below 300 cycles are passed by the first section of the network, which consists of an inductance (L_1) and a red lamp (B_1) connected in series. The inductance, shown in cross section in the drawing, is made by winding 1,500 turns of No. 34 silk-enamel magnet wire on a paper tube three-eighths of an inch in diameter and two and one-half inches long. A laminated core made up of straight iron wires is placed in another tube that is a snug fit inside the coil form. By sliding the core in and out, the inductance of the coil may be varied between wide limits.

Although the second section is a series resonant circuit peaked at 500 cycles, it is so designed that frequencies as low as 250 cycles and as high as 750 cycles are passed. The circuit consists of a four-microfarad paper condenser (C_4), an inductance (L_2), and a green lamp (B_2), all connected in series. The condenser may have a low-voltage rating. L_2 is identical with L_1. B_2 in the



THIS CIRCUIT CHANGES SOUND TO COLOR

The upper view shows the front of the cabinet with the translucent screen removed to expose the reflector and the four colored bulbs. Above, bottom view of the chassis

diagram is a six-volt dial lamp.

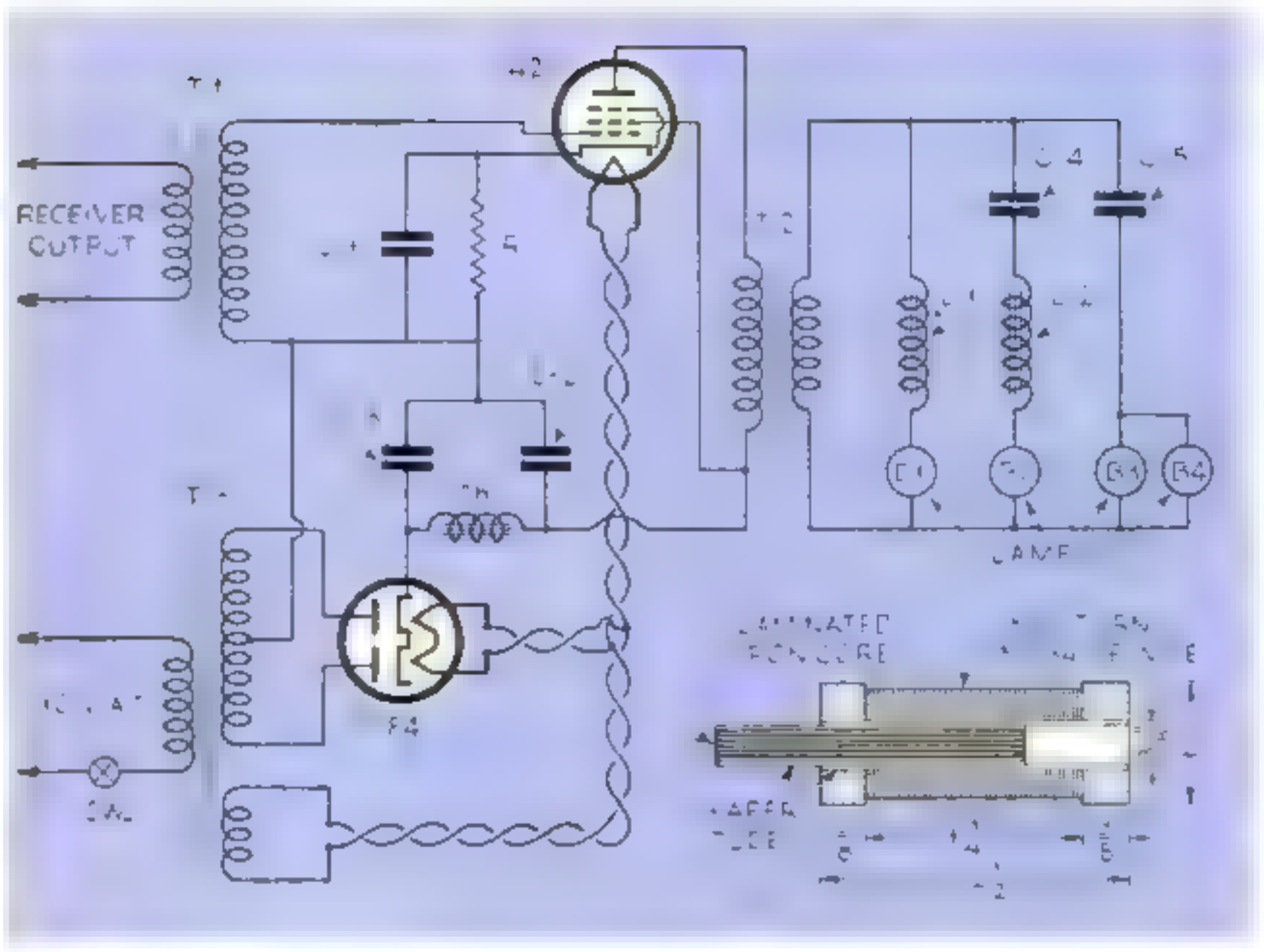
The third network section passes only those frequencies above 600 cycles. It is made up of a two-microfarad condenser (C_5), and two blue lamps (B_3 and B_4). These are six-volt dial lights connected in parallel. The use of two blue lamps is necessary to get a good balance of color.

Due to the overlapping of the frequency ranges, notes between 250 and 300 cycles will cause both the red and green lamps to glow, while frequencies between 600 and 750 cycles will light the green as well as the blue bulbs. This blending gives the intermediate tones and mixtures.

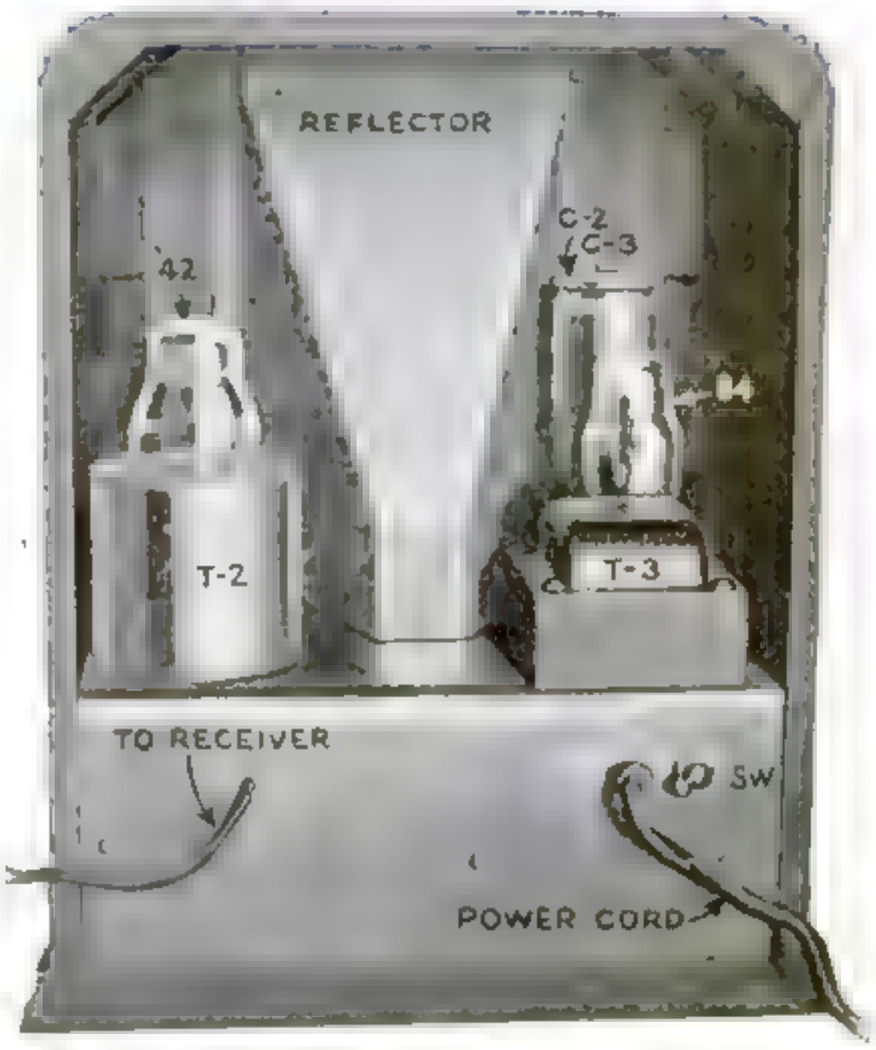
The optical system is extremely simple. It consists of a wedge-shaped, sheet-metal reflector and a rectangular translucent screen made of ground glass or tracing paper cut to fit the speaker opening of the cabinet. The lamp sockets are mounted on the chassis so that the bulbs themselves are at the rear of the reflector. The two blue lamps should be placed side by side at the extreme rear; the green and red lamps directly in front of the blue. The color screens are made of colored gelatin formed into small cylinders to fit over the lamps.

Although the placement of parts is not critical, the arrangement shown in the photographs is suggested as the most convenient layout. Looking at the rear view of the assembly, we see, at the right, the '84 rectifier tube mounted between the electrolytic filter condenser and the power transformer. At the left, the top of the '42 amplifier tube may be seen behind the can housing the network-coupling transformer (T_2). This transformer was sealed in wax to eliminate mechanical vibration of the laminations.

The under view of the chassis shows clearly the construction and placement of the network inductances. The sockets, placed immediately below these coils, may be of the standard type used on illuminated dials, or may be taken from a string of Christmas-tree lights. The power-supply choke and input transformer also show prominently in this view of the chassis.



This circuit diagram shows how easily the color organ can be wired. At the right is a rear view of the cabinet, which was salvaged from an old table-top receiver. Note the toggle switch



In operation, the primary of the input transformer (T_1) is connected across the primary of the speaker-coupling transformer of the receiver (in parallel with the speaker circuit). Usually, the connections can be made directly at the speaker terminal block. If this is not practical, however, they may be made to the prongs of the receiver output tubes by wrapping the leads around the plate prongs if the circuit is of the push-pull variety, or to the plate and screen prongs if the receiver uses a single pentode in the final stage.

To adjust the network, decrease the receiver volume until the lamps glow at a little less than normal brilliancy. Then set the movable cores of the inductances so that the load appears to divide among the lamps according to the frequency of the signal. Bass notes should cause the red lamp to light up brightly, but should have little effect on the others. The average speaking range should cause the green light to glow strongly, while only high notes affect the blue lamps. No adjustment is provided for the latter; they will take care of themselves if the other two are adjusted properly.

Unless a variable audio-frequency generator is available, the inductances must be adjusted by experiment, the appearance of the viewing screen serving as a guide. If the network connections are made correctly and the constants given are followed, the average set builder should have little difficulty. It is important, however, that the network specifications be followed to the letter.

In experimenting with the completed organ, you will find that the best color combinations are obtained from music of the classical or semi-classical type.

Receiver parts composing the circuit are easily assembled. The reflector is seen in the background

LIST OF PARTS

T_1.—Standard audio transformer, 3:1 ratio.

T_2.—Speaker coupling transformer, 7000-ohm primary, 300-ohm secondary.

T_3.—Power transformer, 650 volts CT at 50 mils, 6.3 volts at 2 amps.

C_1.—Tubular electrolytic condenser, 10 mfd., 50 volt.

C_2 and C_3.—Dual electrolytic filter condenser, 4 mfd.

C_4.—Paper condenser, 4 mfd

C_5.—Paper condenser, 2 mfd.

Ch.—Filter choke, 30 henry.

L_1 and L_2.—Network inductances (see text).

R.—Resistor, 500 ohm, 2 watt.

B_1.—Flash-light bulb, 3.2 volt.

B_2, B_3, and B_4.—Dial lamps, 6 volt.

· Latest Ideas in Radio Field ·

Gang Switch Provides Thirteen Contacts

WITH the thirteen-contact, four-position gang switch shown in the photograph above, it is an easy matter to arrange multiple connections wherever needed for radio equipment. Phosphor-bronze contacts and contact points that operate with an automatic, self-cleaning, wiping action insure low-loss electrical connections. The switch requires only a single shaft hole for panel mounting.

Midget Battery For Portables Gives 7.5 Volts

SAID to be the smallest battery manufactured to deliver 7.5 volts, the tiny unit illustrated is the latest addition to the amateur's choice of portable equipment. Besides the full-voltage terminal an intermediate 4.5-volt tap also is provided. The unit gives a bias supply for portable receivers and transmitters.

Adapter Makes Metal Tubes Fit Old Sockets

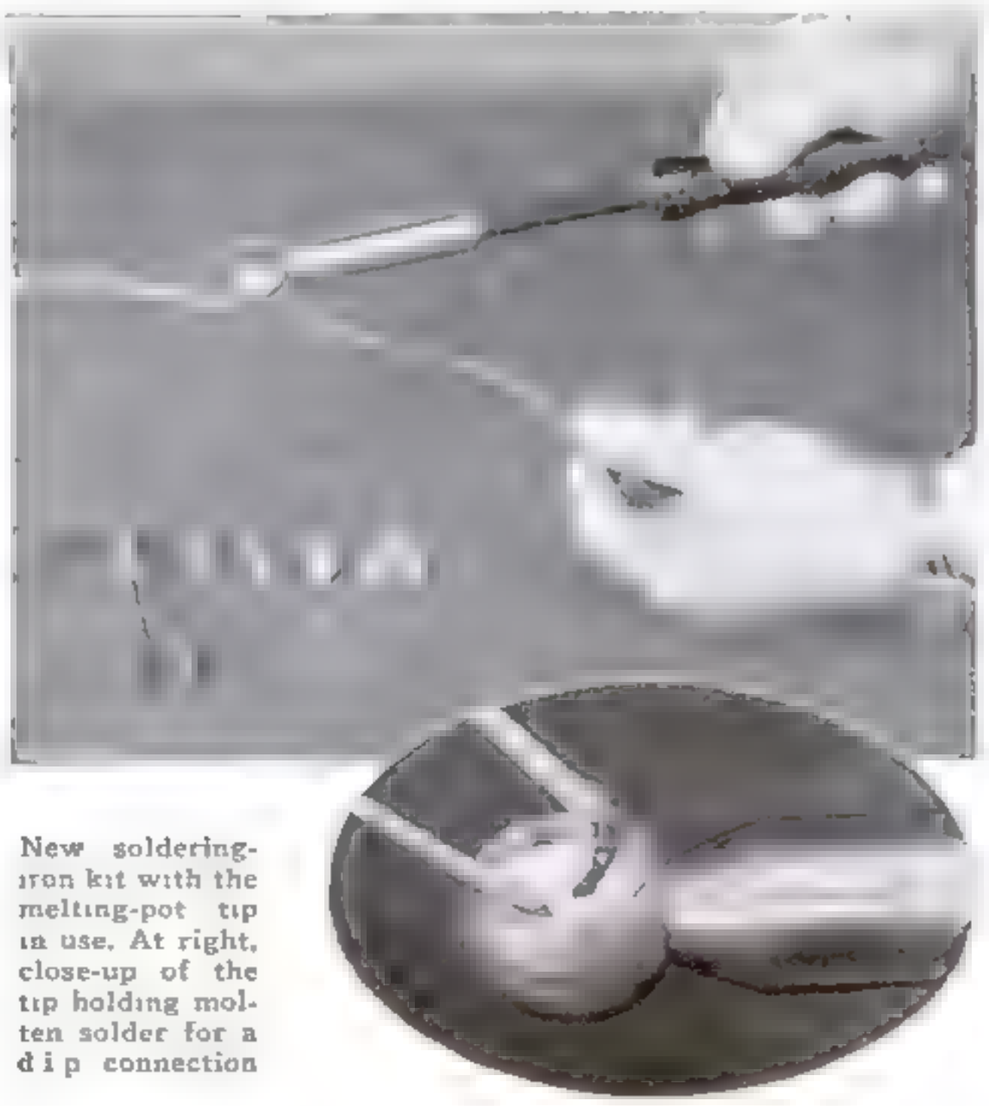
INEXPENSIVE tube adapters for fitting new-type tubes to old-style receivers can be made from two easily obtained parts—tube bases and tube sockets. Simply select a socket to fit the new tube and a tube base to fit the original socket built into the receiver. Then cut the flange from the bottom of the socket, reduce the height of the tube base to about half, solder wires to the socket terminals, and push them through the holes in the proper tube-base prongs. Finally, solder them in place at the prong tip. By pulling the wires taut with pliers, as shown, and then applying the solder, the two parts of the adapter can be fastened rigidly together without the use of a bolt and nut. When ground connection is needed, as in the case of adapters for the new metal tubes, the wire can be brought out through a small hole drilled in the side of the tube socket. Fitted with a spring clip, as illustrated, the wire then can be connected to the chassis at the nearest point to provide a ground for the metal shell or outer container of the tube. Unused tube bases of all types can be obtained from most dealers in radio parts for a few cents. For convenience, wire of the push-back-insulation type should be used for the internal connections.

Connecting wires being pulled taut and soldered at the prong ends on tube adapter

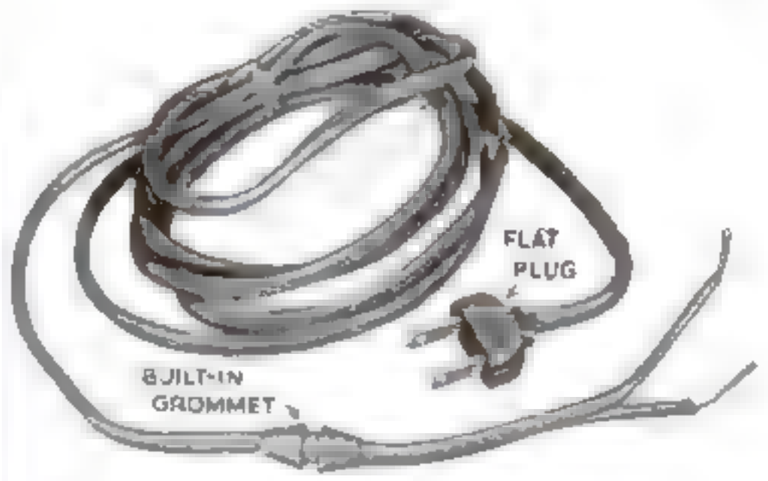
Adapter in use with a metal tube. Left, how socket is wired to base

Electric Soldering Iron Has Melting-Pot Tip

A TINY melting-pot tip is included in the assortment of changeable tips supplied with a versatile electric soldering iron recently placed on the market. Screwed into the nose of the iron, it provides a convenient means for melting small quantities of solder quickly and easily. Other attachments include two regular soldering tips, a narrow right-angle tip for working in tight corners, and a special flat tip for heating and soldering flat surfaces. The adjustable support shown at the left in illustration can be screwed to the edge of the workbench. It is designed to hold the iron horizontal when solder is being melted in the pot or in a vertical position when the flat surface-heating tip is being used.



New soldering-iron kit with the melting-pot tip in use. At right, close-up of the tip holding molten solder for a dip connection



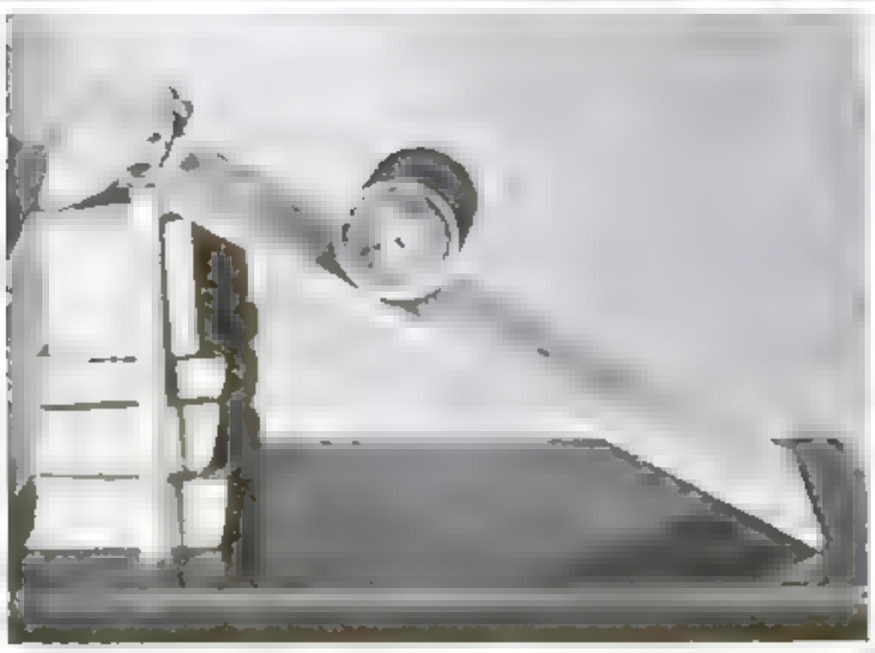
Built-in Grommet Guards Rubber Power Cord

MOLDED in one piece, the new rubber-covered power cord pictured above eliminates many set-building problems. Besides being kinkproof and frayproof, the cord comes complete with a built-in rubber grommet to protect the rubber insulation from chafing against the sharp edges of an aluminum chassis. Being tapered and provided with expansion slots, the grommet is simply forced into the chassis entrance hole to put it in place, and makes a neat, snug fit. A flat, molded connection plug is an added convenience.

Laws of Science

SHOWN BY EASY

HOME EXPERIMENTS



SIMPLE TEST OF INCLINED PLANE

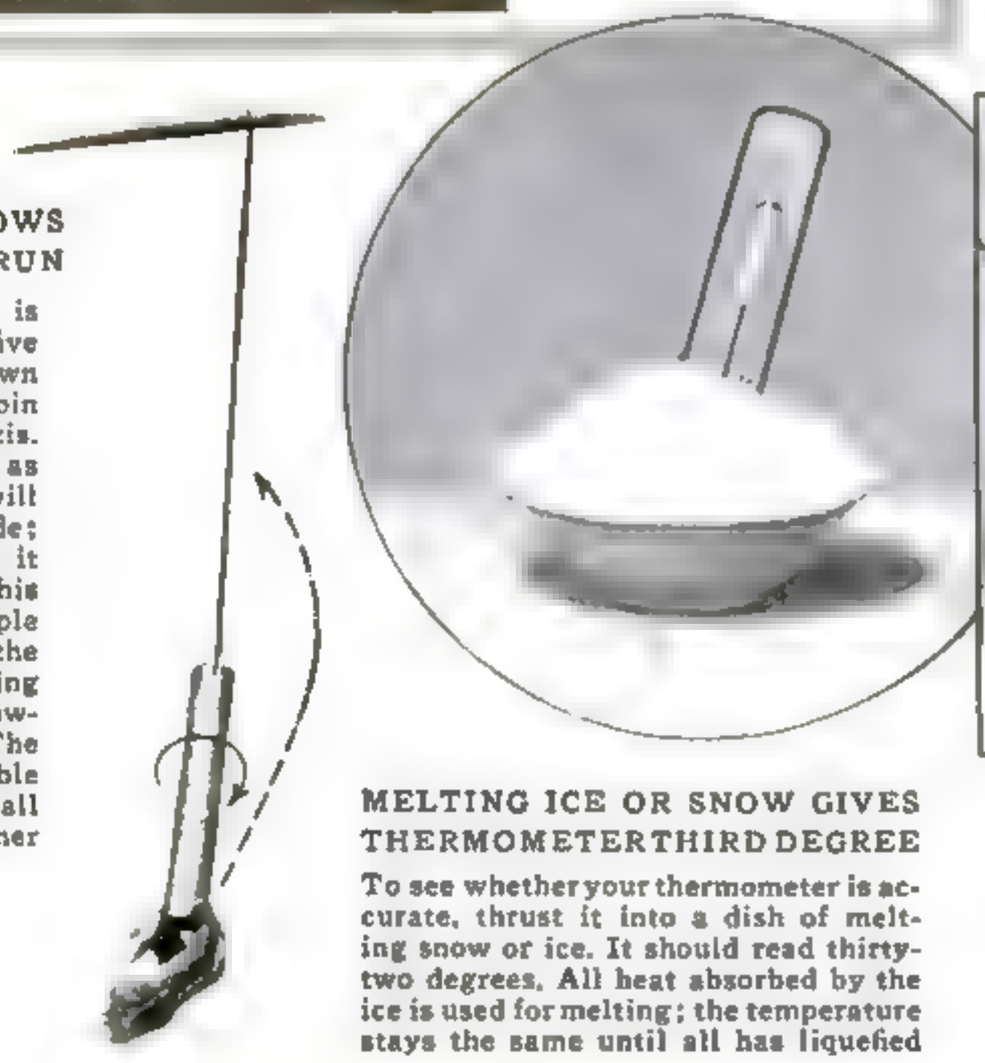
The mechanical principle of the inclined plane can be demonstrated by placing a two-foot board so that one end is higher than the other by one foot. The force required to push or pull a cylinder up the plane will be half its weight. The mechanical advantage (ratio of length to height) is two

A GYROSCOPE SHOWS A STUBBORN STREAK

Spin a flat tin disk suspended by a string, and blow a stream of air upward against the edge. Instead of tipping up where the air strikes it, the disk tips up at a point ninety degrees away. This obstinacy of the gyroscope makes it useful as a stabilizer for ocean liners

SPINNING TUBE SHOWS HOW ROTOR SHIPS RUN

A cardboard mailing tube is suspended on a string five or six feet long, as shown at right, so it will spin around on its long axis. Give it a spinning motion as you swing it, and it will curve sharply to one side; reverse the spin, and it curves the other way. This demonstrates the principle of the rotor ship, with the swinging motion representing the action of the wind blowing against the rotor. The same principle is responsible for the curving of a baseball when it is thrown by a pitcher



A PICTURE OF A MAGNETIC FIELD

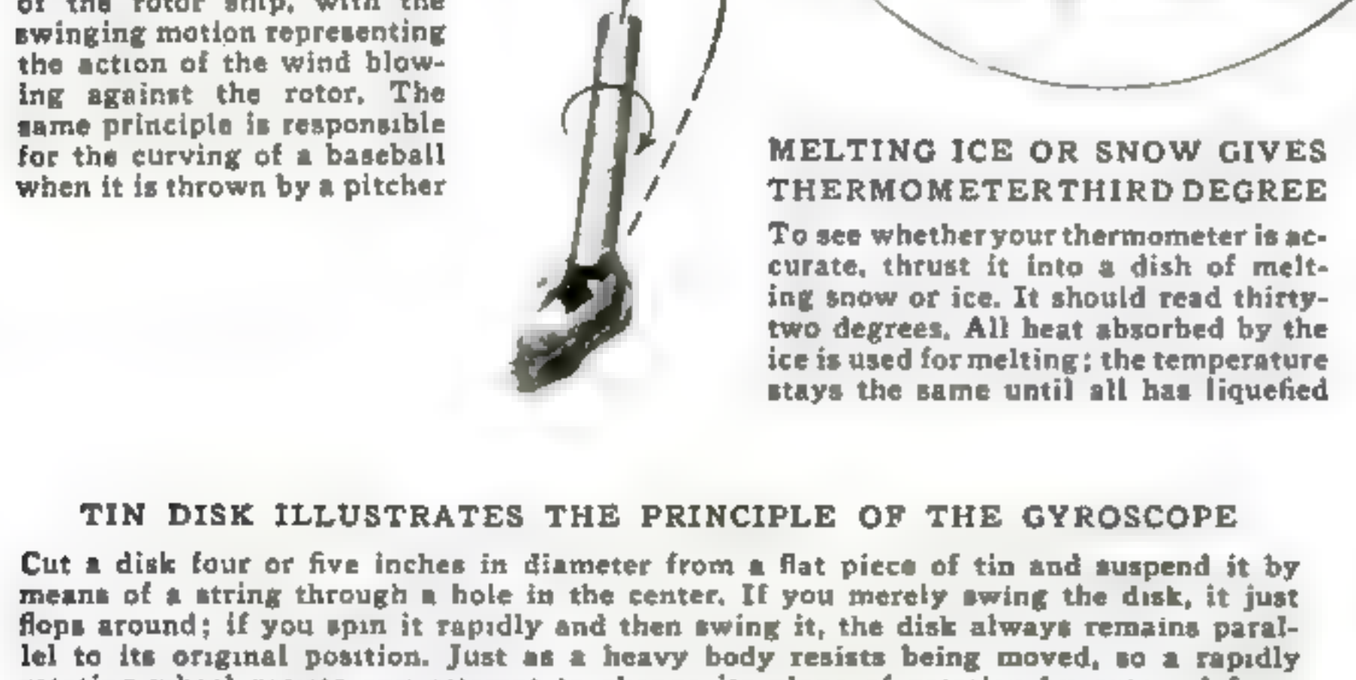
To make a permanent picture of a magnetic field, lay a piece of cardboard across the poles of a magnet and sprinkle iron filings on it. Pour rubber cement over the filings to make them cohere in the positions they have assumed under the influence of the magnet, leaving a permanent picture of the field

MELTING ICE OR SNOW GIVES THERMOMETER THIRD DEGREE

To see whether your thermometer is accurate, thrust it into a dish of melting snow or ice. It should read thirty-two degrees. All heat absorbed by the ice is used for melting; the temperature stays the same until all has liquefied

TIN DISK ILLUSTRATES THE PRINCIPLE OF THE GYROSCOPE

Cut a disk four or five inches in diameter from a flat piece of tin and suspend it by means of a string through a hole in the center. If you merely swing the disk, it just flops around; if you spin it rapidly and then swing it, the disk always remains parallel to its original position. Just as a heavy body resists being moved, so a rapidly rotating wheel resists any attempt to change its plane of rotation by external force



Spinning disk maintains its plane of rotation as it is swung at the end of a string

GAS-FILLED BUBBLES ARE TINY BALLOONS

By connecting a rubber tube to the gas stove, you can make gas-filled bubbles that will rise to the ceiling. They go up because the weight of the gas in the bubble is less than that of air. Keep fire away from bubbles

Check Your Wiring

. . . IF YOU WANT CARE-FREE MOTORING

By Martin Bunn

"All right, buddy, it's not your fault," the cop grinned. "Shuffle along and get that horn fixed."

MRS. HILLON glanced back at the twins smiling like two little angels on the back seat, and then settled herself contentedly against the cushions.

"For once, Fred," she said, "we've started on time. Now, if the car will only behave, we'll get to Aunt Eliza's when we said we would.

"Fred!" she exclaimed, as a car swung out of line and her husband averted a smash only by a quick twist of the wheel. "Why didn't you blow your horn? We almost hit that car."

"Think I don't know it?" Hillon grated. "I pressed the button, but the confounded thing didn't blow. Something must be wrong with it."

"Try it again," she suggested.

Hillon obediently pressed the button for a test, and the horn responded instantly. In fact, it responded too well; it kept blowing for nearly a second after he'd taken his hand off.

"There!" she said triumphantly. "You just forgot to blow it, that's all."

Fred merely grunted. Mile after mile passed under the wheels without any further occasion to use the warning signal and then, as they approached the crossing near the Model Garage, the tall, hard-boiled cop directing the Sunday traffic at that point majestically held up his hand.

Fred slammed on his brakes and as the car rolled to a stop the horn let go with a long and disconcerting blast.

The cop glared angrily, and deliberately turned his back as he motioned to the traffic flowing in the other direction.

"Whatever did you do that for, Fred?" Mrs. Hillon wailed. "You'll make the officer angry and then he'll give you a ticket or something."

"The blamed horn blew itself," Fred muttered. "I didn't have my hand within a mile of it." The horn punctuated his remarks with three short blasts.

An ominous frown gathering on his face, the cop held up traffic in both directions and swaggered over to the Hillon's car.

"Say, how do you get that way, mister?" he growled. "In a hurry are you? Well I'll show you. Lemme see your license."

Hillon started to protest, shrugged his shoulders hopelessly, and reached for his pocketbook.

While he was fumbling with the buttons of his overcoat and the cop was digging for his summons pad and pencil, the horn let loose upon what promised to be the nonstop record for horn blowing.

"Hey! Shut that blasted thing off!" roared the cop.

"Shut it off yourself, I can't," Hillon shouted despairingly, as he punched and pulled at the horn button.

"So it ain't your fault, eh!" boomed the cop as his gnarled face broke into a twisted grin. "All right, buddy, shuffle along to that garage and have it fixed."

Mrs. Hillon smiled gratefully, and the car drove off with the horn still sounding its raucous blare.

Gus Wilson, veteran auto mechanic of the Model Garage, took in the situation at once as the prolonged honking brought him outside. He fished a screw driver from a pocket in his overalls and disconnected the wire at the horn.

In the intensified silence that followed, Mrs. Hillon piped up. "Isn't that lucky, Fred? Cousin Harriet lives just a little way down the road. I'll take the children and pay her a visit while you get the horn fixed, and I'll phone Aunt Eliza that we'll be late—as usual!"

Gus pulled the horn-button assembly apart and found the trouble. The wire had come loose and was resting in such a way that the bare end made contact with the metal of the steering-wheel post at the slightest vibration.

"Gosh!" exclaimed Hillon, as he glared at the loose wire end. "I wish that just once we could start out and get where we're going without some wire giving trouble. Last week it was the headlights. The time before that it was the stop light. I wonder what it will be the next time?"

"Lots of old cars get that way," Gus observed. "Trouble is, the owners don't realize just what makes a good electrical connection, and they don't know where to look for trouble before it actually breaks.

"Of course, if a car owner always fixed a bad connection right when it did go back on him, after a while his troubles would be over because all the bad connections would show up and be fixed for good. But usually, when a light goes dead or something like this horn trouble happens, the wire is put back any old way, and sooner or later the trouble shows up again in the same place.

"Look here," Gus suggested, tapping the horn-button assembly with his screw driver. "The end of this wire is supposed to be held in place by this spring connection. That's fine if the spring is strong, but this one is so weak that the vibration gradually worked the end of the wire loose and it dropped out. If I put it back the way it is, you'd have the same trouble again in a few months. I'll tighten the spring first, and then I'll bet it won't happen again while you have the car."

"I can understand that, easy enough," Hillon agreed, "but last time, when one of the headlights went out, I couldn't find any loose wire. *(Continued on page 131)*

Glass-Topped Furniture Novelties

Working drawings for five unique but easily built occasional tables, and a new style magazine holder to match

By DONALD A. PRICE

A small, general-utility stand of this type is not difficult to make, yet it is decorative and has a special appeal to housewives because the glass top will not show burns or stains

THE use of glass for the tops or upper shelves of the tables illustrated on this and the following page provides a surface that is proof against stains, tumbler marks, burns, and scratches. Glass may also be incorporated directly into other small, novel pieces. One example—a magazine "basket" with glass sides—is given.

If walnut or mahogany is chosen for the wooden parts of this type of furniture, a conservative effect is produced. Maple pieces, appropriately stained, may be used harmoniously with Early American furniture; and maple or other light wood finished in a natural shade gives a very modern tone to the design.

Fear of successfully working the glass itself need not deter the amateur craftsman from utilizing these designs. He can purchase the glass already cut, ground, and polished to fit his frames at a surprisingly small price from a glass dealer, preferably one who specializes in store-front work, who usually has remnants left from trimming large plates. For example, the top for the half-round end table shown in the illustration in the lower right-hand corner of this page cost $1.35 complete, made from new ¼-in. plate glass. The price for the same top made from salvage plate or new crystal plate was 70 cents.

On the other hand, the craftsman who likes to do every operation unaided, need not hesitate to cut and grind the glass himself. The sides of the magazine "basket" illustrated were finished by the method and with the equipment to be described.

Make a template of ¼-in. plywood, at least for cutting the curved edges. The template should be smaller than the required outline by the amount of the offset of the cutter used. Use a cutter that is sharp—one that will produce a continuous cut with one stroke. Tap the glass under the cut on the curves, to start a cleavage. Make radiating cuts in the waste stock on the curves of small radii. Work on a flat surface packed with newspapers. On straight cuts, tapping is not necessary. To break off the waste glass after making a straight cut, place the glass with the extra stock projecting over the edge of the table and have the cut directly over this edge. Then press firmly as shown in a sketch near the end of this article. If only a narrow strip is being broken off, nibble away the edge with pliers.

The grinding may be done successfully on an ordinary sanding disk if its speed can be slowed down to about 300 r.p.m. Such a speed is available on a metal-turning lathe, or on a wood lathe capable of being slowed down, such as that shown in the illustration of the glass-grinding operation. The slow speed is essential because the corners of the glass will chip if ground at too high a speed.

The rough grinding to outline is done with No. 1 garnet paper, and the final polishing and rounding of the edges with a No. 00 sandpaper disk. A smooth, soft pine board is used between the glass and the metal table, as shown. This lessens the likelihood that any grit which may get under the glass will leave scratches. As an additional precaution, brush off the support every time the glass is lifted for inspection.

A half-round end table with a top of ¼-in. plate glass. For drawings, see the next page

The edge is beveled with the table tilted to 45 deg. and is finally rounded off by holding the glass against the disk by hand after the table has been removed. As a final touch, light oil is rubbed on the polished edge.

A very satisfactory edge was obtained in the manner just outlined, but the polishing may be carried further, if desired, by hand lapping the edge with a fine abrasive.

Any standard cabinet wood may be used, providing it is well seasoned. Any considerable shrinking or warping of the wood after fabrication would be fatal to the glass. The joints must fit well for rigidity. In the drawings, the joints are all shown as held together by screws alone. However, it is advisable also to glue the grooved joints between wide boards, such as those between the handle and bottom of the magazine rack and between the shelves and wide uprights of the end and coffee tables. Countersunk screws concealed with plugs will give a more finished job. If this is done, it will still be necessary to attach one member by means of removable screws for inserting the glass members; for example, the glass-retaining molding on the half-round table and one leg of the round table.

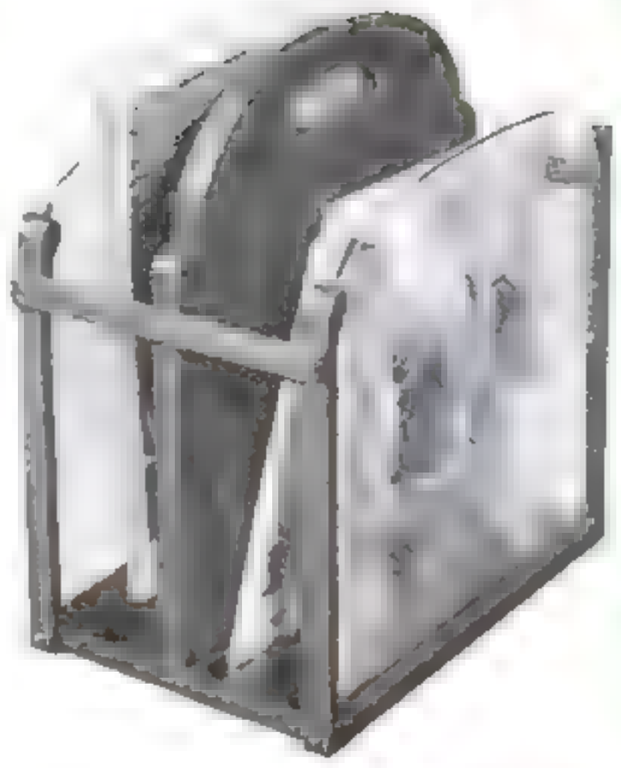
The glass in the magazine "basket" is entered into its grooves by taking off the vertical glass moldings and the crosspiece as a unit at one end only.

For convenience in finishing, take apart the assembled piece except where glued joints prohibit. Use especial care to produce a flat, perfect surface with scraper and sanding pad on the sidepieces. If the wood is to be darkened, apply oil stain with a brush. It may be allowed to dry several hours before being wiped.

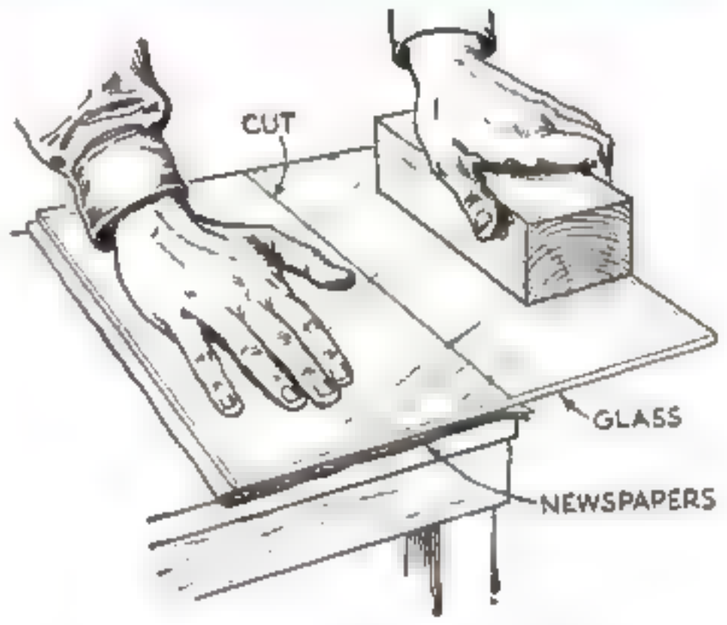
Darken the filler with the same stain and thin with turpentine till it spreads easily. Allow this coat to dry till it becomes dull, and wipe off across the grain, rubbing hard to work the paste into all the pores. Allow the filler to set for an hour and use a clean rag to polish off any filler streaks on the surface. Let the filler harden at least twenty-four hours and polish hard again with a dry rag before giving a wash coat of thin shellac. Rub down hard with steel wool.

The first coat of varnish is leveled off with No. 5 sandpaper of the wet-or-dry type used with water; the second coat, with No. 8 sandpaper of the same type and water. Then rub the surface dull with pumice and oil on a felt pad.

Clean off the piece thoroughly and apply regular furniture polish.



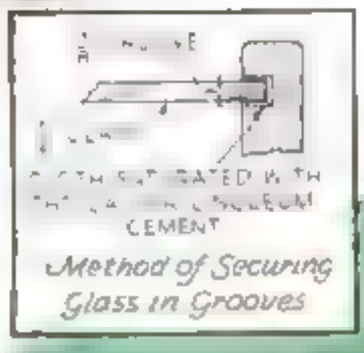
A distinctly modern magazine rack with glass sidepieces. It was designed as a companion piece to the various glass-topped occasional tables shown in the other illustrations

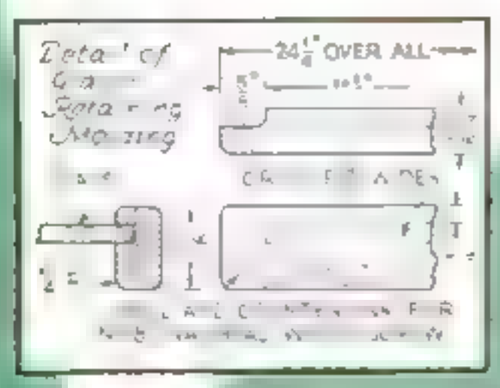


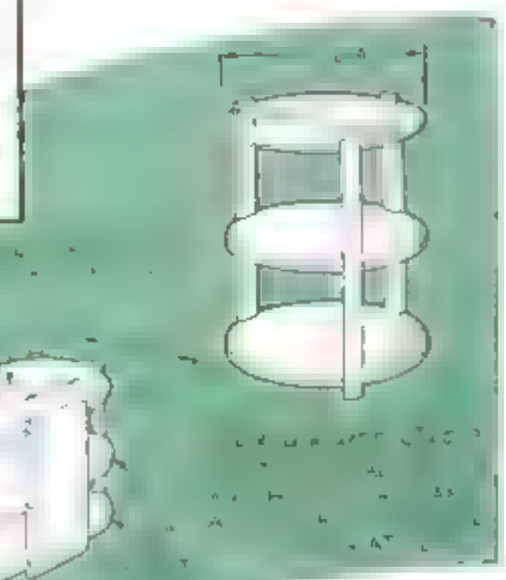
After making a straight cut, place it over the edge of a table and break off the waste

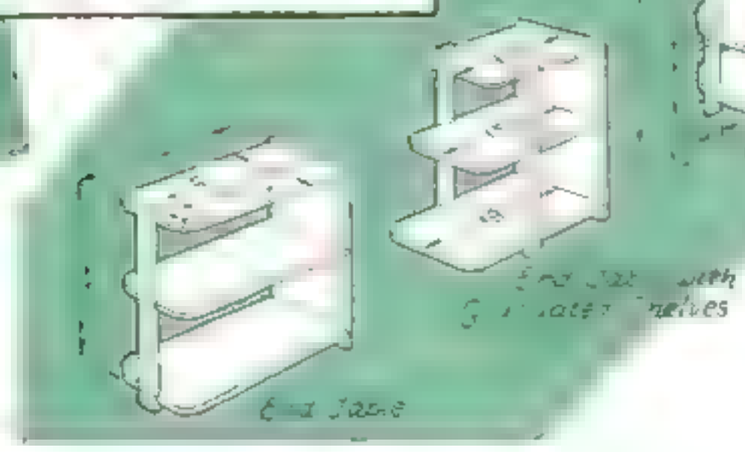
The edges of glass tops can be ground successfully on a sanding disk set up in a metal-turning lathe or in any woodworking lathe that can be slowed to about 300 r.p.m.

The wooden framework for any of these pieces can be prepared with speed and accuracy if a circular saw table is available for getting out the stock and cutting the grooves









Front and top views of the half-round end table shown in the photograph at bottom of preceding page; and, in the adjacent panel, a detail drawing of the top to illustrate how the molding is machined for holding the glass in place

Suggestions for making four different tables, all with tops of plate glass. Many variations can be worked out. The method of fastening glass is shown above

STEAM-ELECTRIC Wall-Paper Remover

COSTS A DOLLAR TO MAKE

By Walter E. Burton

REMOVING wall paper, even if it is several layers thick, becomes a simple matter with a steam-electric remover, which any one handy with tools can build at small expense. Steam, generated in a reservoir heated by electricity, penetrates the paper and loosens the paste more efficiently than any amount of ordinary soaking with water.

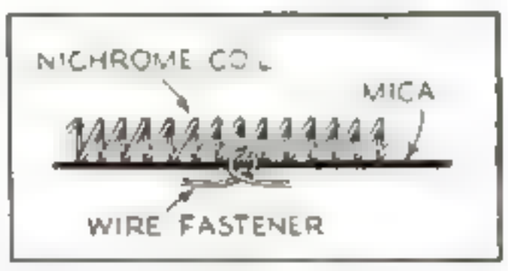
The remover illustrated was assembled from baking pans and other articles obtainable at the average "five-and-ten" or hardware store. The cost was about one dollar.

Two rectangular tinplated bread pans, one considerably smaller than the other, are needed. The larger pan forms a hood for directing the steam against an area of the paper equal to the area of the open top of the pan. The smaller pan, which should be of the same relative shape, is mounted inside the larger one, after being converted into a steam generator.

This conversion involves most of the work on the remover. The heating unit consists of a length of coiled resistance wire, consuming from 550 to 600 watts of current. This is mounted so that it heats an area covering part of the bottom and part of one side of the small pan. You can purchase coiled resistance wire at any electrical store in the form of springlike replacement units for toasters and similar devices.

Obtain two sheets of mica, 4 by 5 in., which will cost about 15 cents each. Stretch the resistance wire slightly to separate the coils, and mount it on one of the mica sheets, arranging it in the form of the letter M, as shown. To fasten the wire to the mica, punch two small holes about 3/16 in. apart in the mica, and run a short

Although this electrically operated remover is so inexpensive to make, it will steam off two layers at once



The resistance wire, shaped into an M, is fastened to the mica with short loops of wire

piece of nichrome or iron wire through them, looping it through one of the resistance coils. The ends of the resistance coil are looped about small brass bolts inserted through holes drilled in the mica.

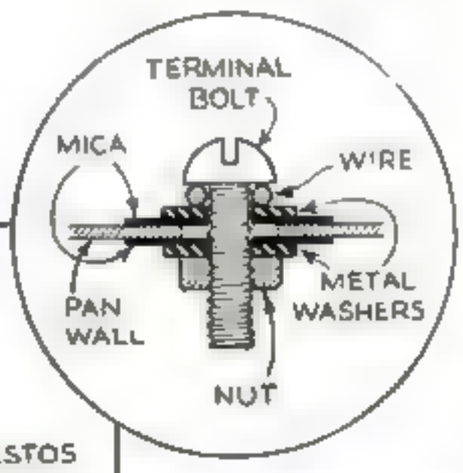
Bend the mica sheet bearing the resistance wire so that it fits snugly against part of the bottom and a side of the pan, as illustrated. Bend the other mica sheet the same way, so that it forms an insulating layer between the wire and the pan bottom. A piece of asbestos and a sheet of copper or tin plate serve as a backing for the heating unit. These five layers—mica, wire, mica, asbestos, and metal plate—are held in place by two clips made of heavy gauge copper or brass and riveted to the pan bottom and side. Be sure the rivet holes do not let water leak out.

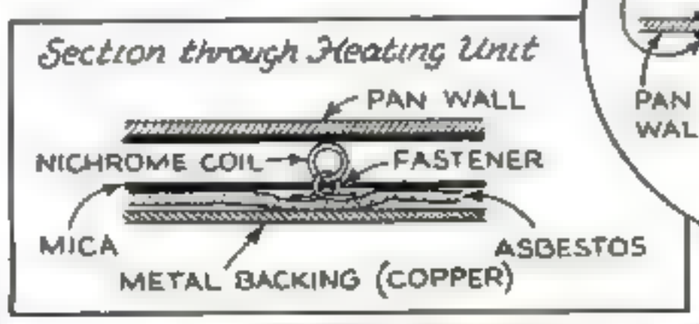
The two bolts forming the heater terminals must be insulated from the metal back plate. This is accomplished by punching or drilling holes considerably larger than the bolts and then using mica washers and brass nuts to clamp the bolts rigidly in the centers of the holes.

The open top of the smaller pan must be covered with a sheet of tin plate in which has been cut the hole (or holes) for the escape of the steam. The photographs show a single hole in the center of the plate, but experience has indicated that two holes, one near each end, would provide better steam distribution. Cut the holes in any convenient manner, making them about 1 in. in diameter; and then solder, to the inner surface, short tubes made by bending strips of tin plate around a cylindrical object. These tubes must be of a length slightly less than half the depth of the pan. Their purpose is to prevent water from running out when the remover is turned upside down or tilted on its side. Solder the tin-plate cover to the pan edge, making sure there are no leaks.

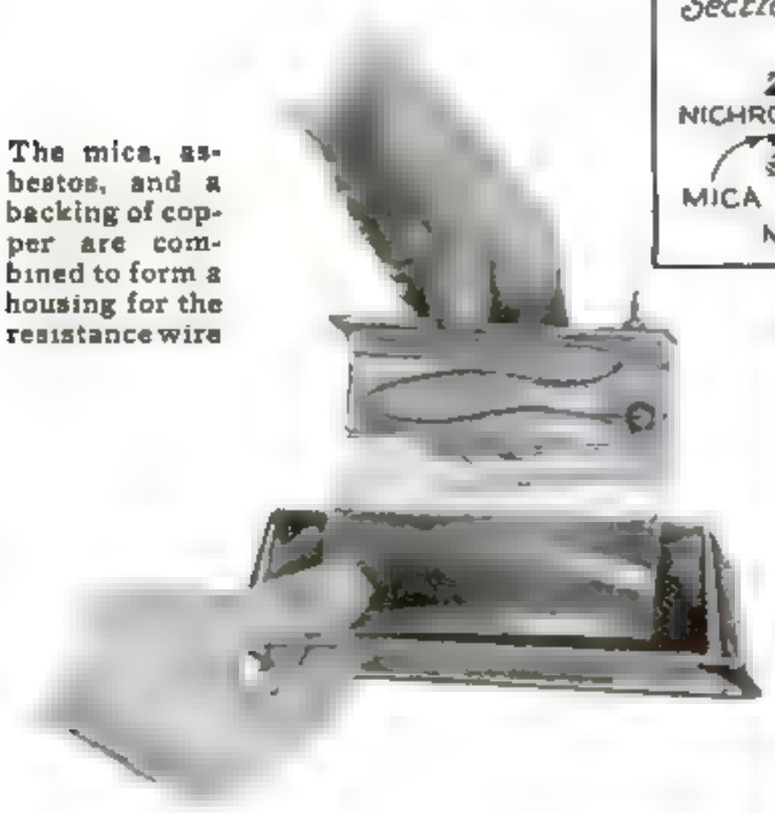
Mount the steam generator inside the large pan, placing it so that *(Continued on page 112)*

The method of insulating terminal bolts is shown at right, and the heating unit is diagrammed below





The mica, asbestos, and a backing of copper are combined to form a housing for the resistance wire

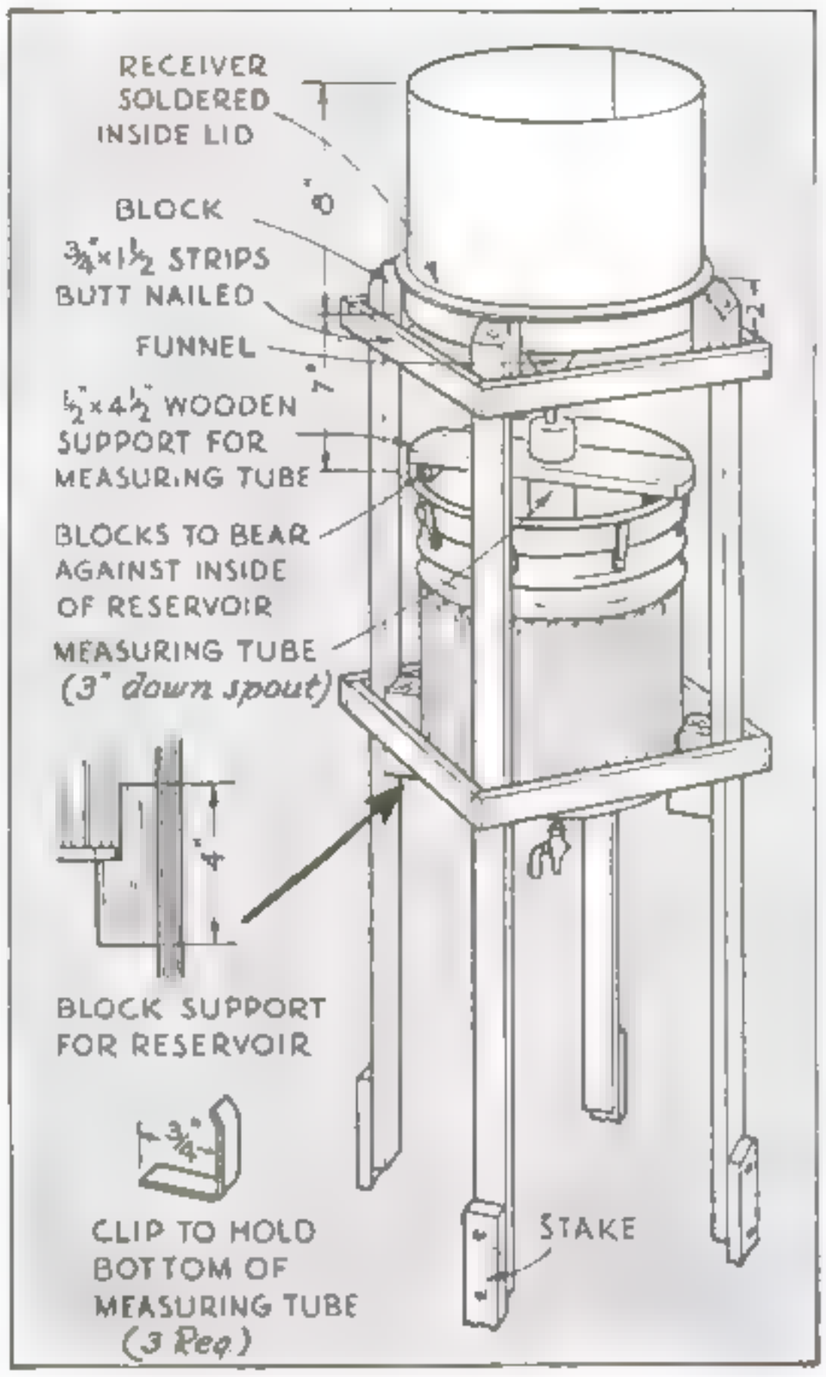


The heating unit is fastened to part of the side and bottom of a bread pan by two sheet-metal clips

HOW TO CONSTRUCT An Inexpensive

An accurate instrument that can be used with a plain measuring stick or arranged to record automatically

The rain gauge set up for use. The drawing shows method of assembling the nonrecording type of gauge, but with the middle section removed so that the funnel and inside measuring tube can be made visible



If the rainfall has been especially heavy, the overflow in the reservoir is measured by draining it into the measuring tube

By Edwin M. Love

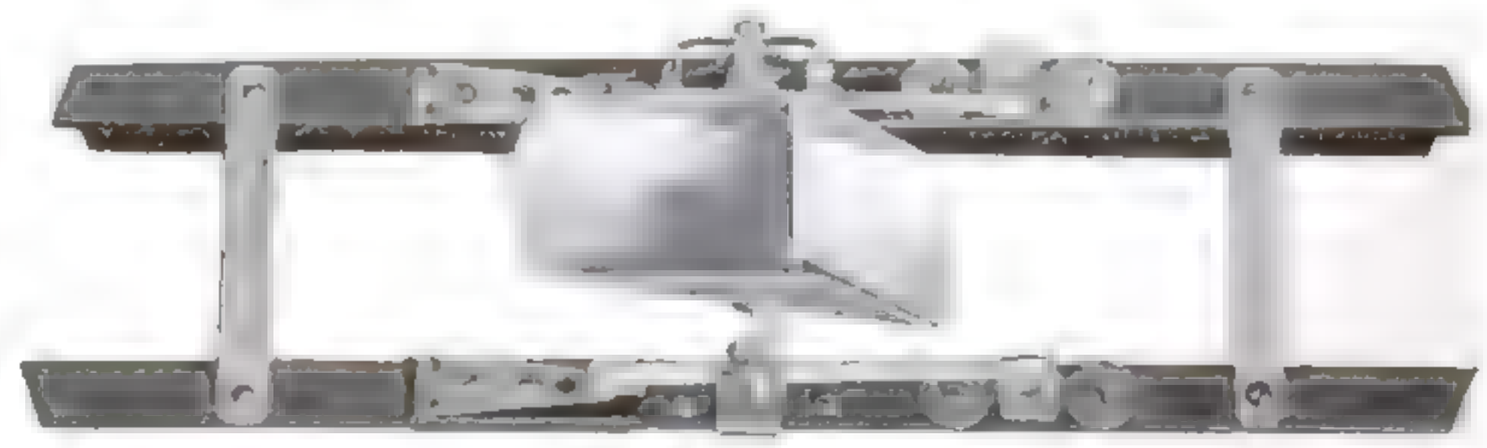
IT IS a simple matter to measure rainfall. For heavy downpours, all that is necessary is to set a basin with vertical sides out in a space protected from wind, and measure directly the depth of the water caught. For light rains, it is better to magnify the depth by catching the rain in a wide funnel and letting it drain into a narrow tube.

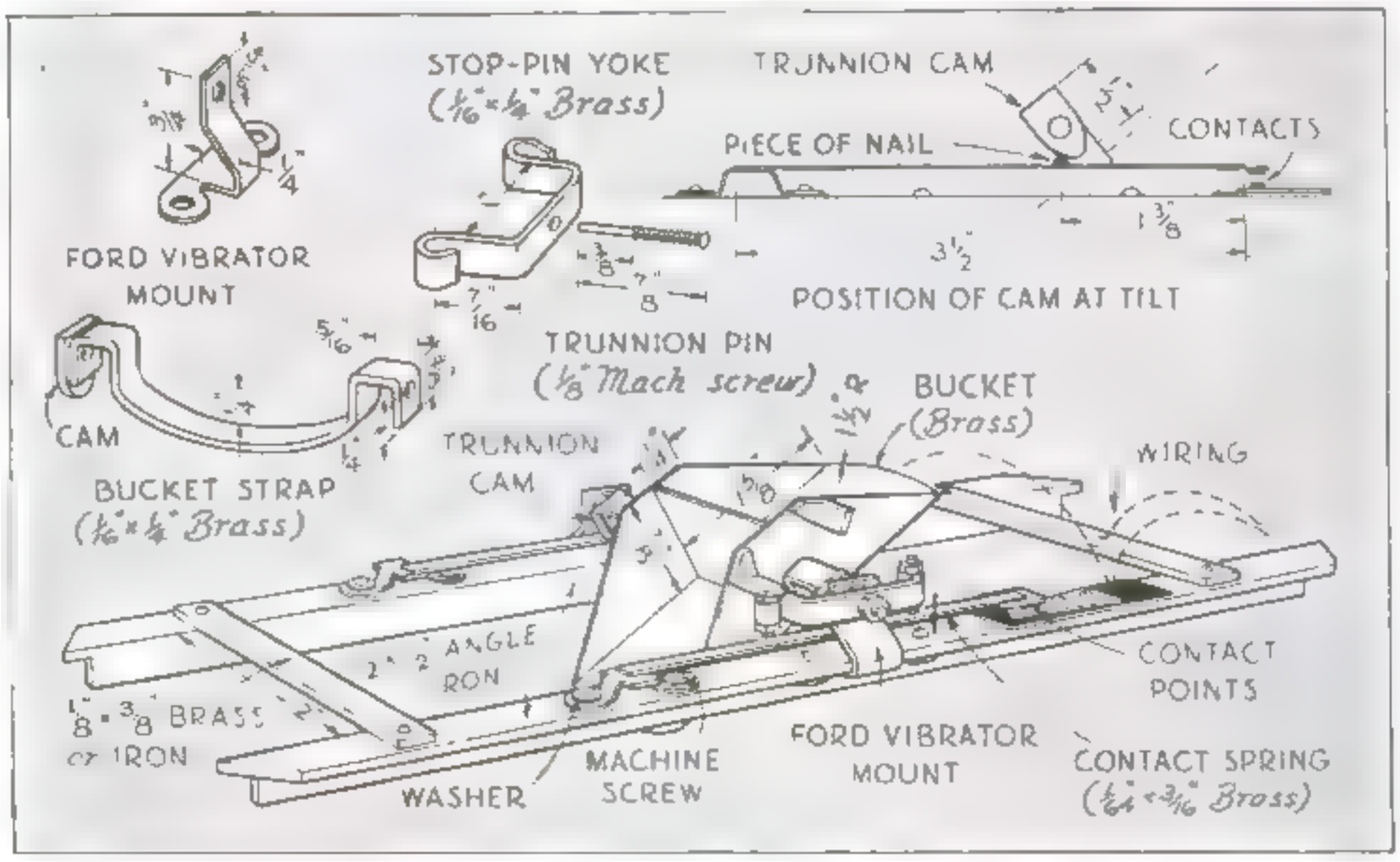
Such simple rain gauges are not satisfactory, however. Light rainfall, caught in the open basin, may be hard to measure, and a narrow tube may overflow in heavier rains, making it impossible to learn the total fall.

The gauge to be described is simple and inexpensive, yet it avoids the troubles just mentioned. It is complete in itself; but for those readers who wish to know the fall during any given period, in addition to the total for the day or storm, an easily built recorder is also described.

The most easily obtainable vessel is a small galvanized garbage pail fitted with a lid. A fifty-cent one about 11½ in. in diameter and a foot deep is good. If you live in a locality of heavy and prolonged rainfall, you may wish to get a deeper one. Obtain also a funnel about 4 in. in diameter, a 16-in. piece of 3-in. galvanized down spout or brass tubing, and two strips of galvanized sheet iron. One of the strips should be 9 in. wide, the other 8 in., and both long enough to encircle the can with ½ in. to spare for a lap.

This pail is the reservoir. Remove the





A photograph of the recording-bucket assembly and its supporting frame, a sketch of the same mechanism to show the construction more clearly, details of several parts, and diagram of cam

RAIN GAUGE

bale, and pound down the raised rings in the bottom with the end of a hammer handle, which will cup it, making it drain better. Punch a small hole in the center and solder on a brass drain cock.

The inverted lid serves as a receiver. Beat it down like the bottom, for improved drainage; then cut out the center and solder on the funnel. Sides must be built up to keep the rain from splashing out. Coil the 8-in. strip of iron inside the flange and press it outward with a stick wedged inside, while tacking it outside with solder. When it is securely fastened, solder the seam.

The measuring tube is cut square at both ends, and a bottom soldered in. If the seam leaks, that too must be soldered. This tube stands upright in the center of the reservoir, being held by a wooden collar resting on the top. The ends of the collar must not project, as they would interfere with the center section when it is put in place.

To steady the lower end of the tube, solder three brass clips to the bottom of the reservoir. Inclined inward, with their top ends bent out, they bear against the tube and hold it firmly.

The center section, made of the 9-in. strip of sheet metal, fits outside the lid (bearing against the roll rim), and outside the top of the reservoir. For the neatest job, it should be tapered in diameter, but this is unnecessary, as it clasps over the reservoir and prevents unmeasured rain from blowing in. Bend eight clips of strip brass to solder around the reservoir The lower edge of the center section rests in these clips.

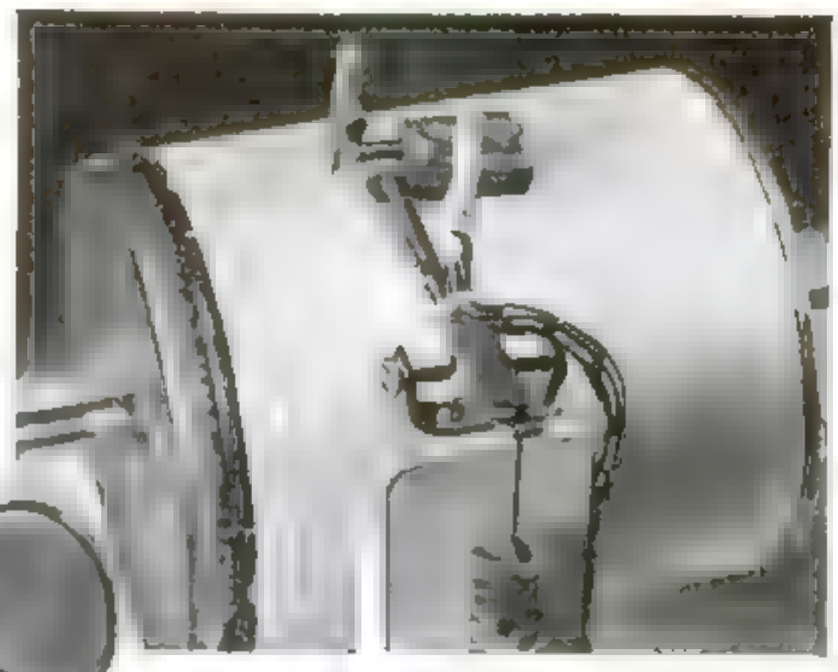
This completes the gauge itself. The wooden stand is built of two square frames large enough to enable the reservoir's being inserted from the top, and uprights set at 45-deg. angles inside the corners as shown. Space the frames so that the bottom of the gauge rests on the blocks about ¼ in. below the lower square, while the underedge of the lid bead is 2 in. above the top of the upper one. The legs of the uprights should be long enough to allow the measuring tube to be stood under the drain cock. Paint the stand gray or white and anchor it with screws to stakes driven outside of the legs.

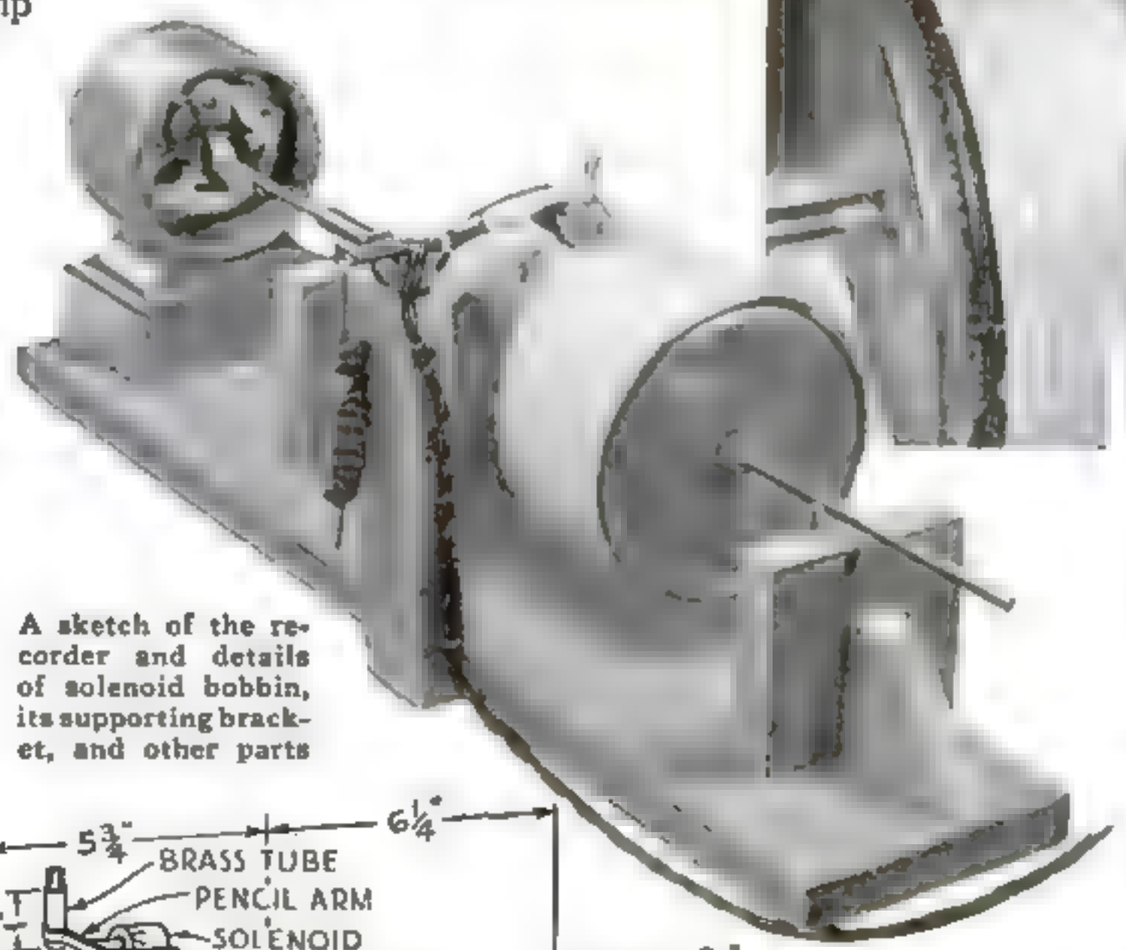
Install the gauge where it is protected from the wind, which otherwise might prevent the receiver from catching a true amount of rain. Shrubs, fences, and the like are beneficial around the instrument, but must not be nearer than their own height.

Unless considerably more than an inch of rain has fallen, all that is necessary to take a reading is to insert the stick into the tube

Measurement of rain is made in this way: True up the wall of the receiver so that the upper edge is as round as possible, take measurements of the diameter at several places, and figure the average in inches. Likewise find the diameter of the measuring tube. Square these figures, and their ratio gives the magnifying effect of the gauge. In the case of my gauge, this was 15.32. Now, if a calibrated stick is thrust into the tube, the height of water collected can be measured. However, the stick occupies space and raises the water level, and the sectional area must be subtracted from the sectional area of the tube. In mine, the stick was ¼ by ½ in., thus reducing the tube section by .125 sq. in., or making it 6.665 sq. in. Since the receiver area is 103.8 sq. *(Continued on page 103)*

The views below and at the right show the recording unit which makes a mark on paper for each .01 inch of rain. The time also is indicated

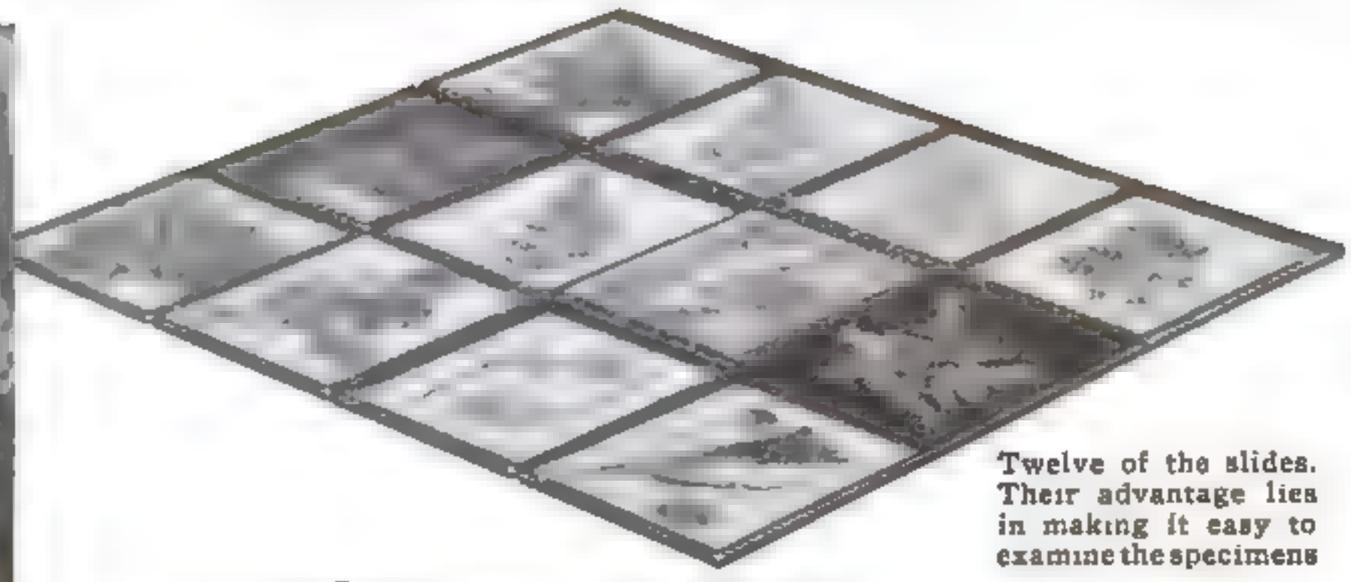




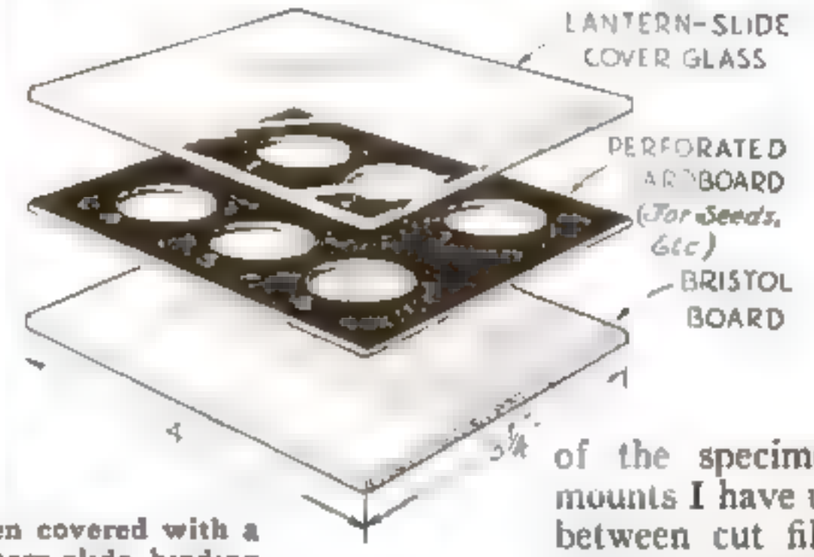
A sketch of the recorder and details of solenoid bobbin, its supporting bracket, and other parts

Small Plant Specimens Mounted Under Glass

Arranging a specimen on a cardboard backing sheet. It is then covered with a lantern-slide cover glass, and the whole is fastened with lantern-slide binding



Twelve of the slides. Their advantage lies in making it easy to examine the specimens



WHEN botany students or interested amateurs want to preserve their plant specimens, they usually mount them on the standard 11½ by 16½-in. herbarium sheets, which are then placed in shallow drawers or assembled in book form. This is quite satisfactory for classifying and examining the larger plants, but is cumbersome when small, delicate forms of plant life are to be studied.

While going over some herbarium sheets of ferns and lichens with a hand magnifier, I realized the need of mounting these interesting parts in a more convenient size for quicker handling and easier study.

As the best size for this purpose, I selected the standard 3¼ by 4-in. lantern-slide cover glass—the thin glass that covers the finished lantern slide to protect the delicate film. Every part of its area may be observed when placed on the regulation size stage of the dissecting or compound microscope. The glasses may be obtained at all large photographic supply stores. The other essentials are: cardboard or Bristol board, lantern-slide binding strips, and some adhesive for fastening specimens.

To contrast harmoniously with the specimen, or for photographic reasons, I used different colors for a background—white, black, and the lighter and darker shades of gray and tan or brown. Smooth white Bristol board serves for most of the specimens, but for the colored mounts I have used the black paper placed between cut films and various catalogue covers and cardboard boxes. The cardboard is cut to size on a photographer's trimming board; or, lacking this, they can be cut with a mounted razor blade or large shears.

Arrange the specimen on the cardboard and put a little adhesive under the larger parts of the specimen to hold it in place. Clean one of the cover glasses, place it over the specimen, moisten one of the binding strips, and fasten the edges of glass and cardboard.

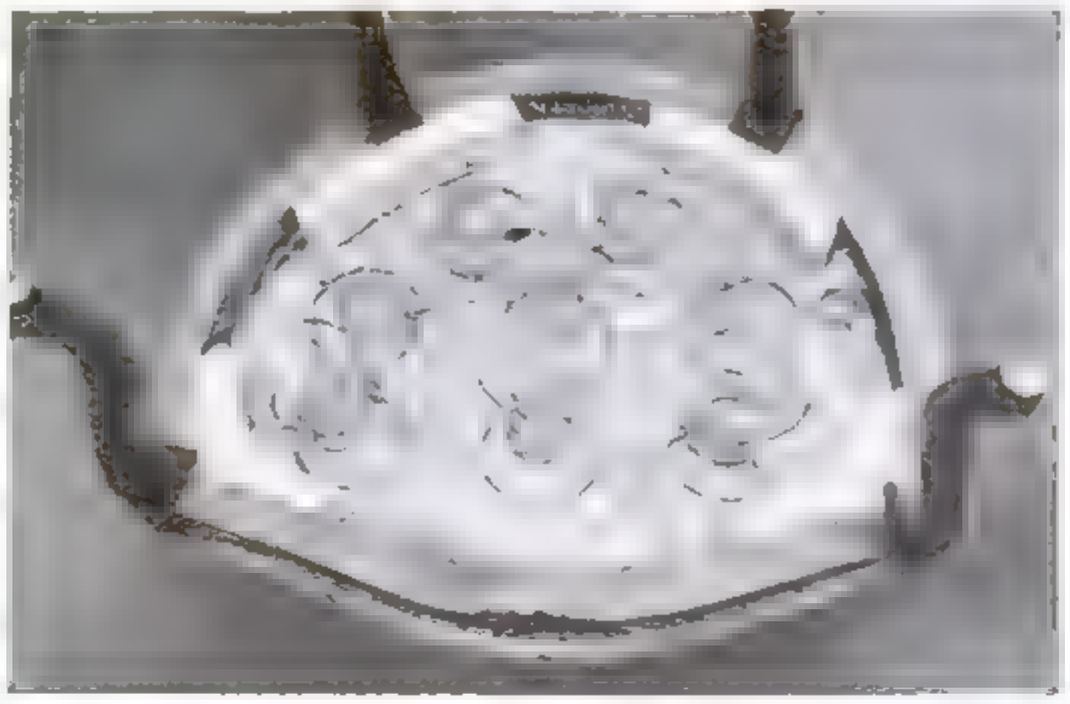
If ¾- or 1-in. holes are punched in the cardboard and a piece of Bristol board is placed under it, seeds of various kinds can be mounted for easy study with the microscope.—CHARLES H. KRUCHTEN.

EASY WAY TO REPAIR SHAKY ARMCHAIR

UPHOLSTERED chairs, especially antique ones, have a bad habit of contracting the wabbles, because long-continued use breaks down the glue in the leg joints. As soon as the joints weaken, the chair will sway under the weight of the sitter. Regluing means tearing the chair apart, and this involves replacing stuffing and upholstery—a job to be avoided. Instead of attempting this, turn the chair bottom up, remove the dust cover and webbing, and cut a block of soft pine to fit in each corner, as shown. Make a template of cardboard and fit it by the cut-and-try method; then transfer the markings to the wood. A piece of "two by four," 3 ft. long, is more than ample for all pieces.

Mix casein glue extra thick and apply generously to both the chair and the block. Hold the block in place with C-clamps, and use pads to avoid denting the chair. Squeeze hard so the soft wood of the block will yield and be forced into positive contact with the corner. Should the leg joints show a tendency to open under the pressure, place a bar clamp across the legs until the C-clamps are drawn tight.

Now replace the old webbing with new, stretching each piece tight before cutting. Sew the springs in place and put on a new dust cover.—ALEXANDER MAXWELL.



Carefully fitted and glued corner blocks will strengthen a wabbly upholstered chair and save the work of taking the chair all apart

VACUUM BOTTLE IMPROVED BY ADDING HANDLE

PINT and quart vacuum bottles are so clumsy and awkward to handle that any number of them are broken every year by being dropped. Such accidents are always annoying, and a new glass reliner costs almost as much as a new bottle. To save this expense, the writer hit upon the idea of attaching a handle to a vacuum bottle.

Obtain a stamped-metal drawer pull. Then unscrew the outside metal case of the vacuum bottle, remove the glass container, and solder the pull on the external metal shell, as illustrated. Improved in this way, the vacuum bottle can be held safely for pouring even by a child, and you can wash it without having it slip out of your hands.—JOHN EDWIN HOGG.

HOMEMADE
ELECTRIC PEN

Burns Designs in Wood and Leather

Can be fitted with tips for all kinds of pyrographic work . . . Marks initials indelibly on tool handles

By Kenneth Murray

YOU will enjoy decorating wood, leather and other materials with this easily constructed electric pen, which has several novel features not found in other pens of this type. For example, in an instant you can change from a tip which burns narrow lines to one that is broad and large for burning in backgrounds. It is not necessary to wait for the point to heat up, as it becomes glowing hot immediately the current is turned on, and cools almost as quickly when you want to use another tip. This means that it is exceptionally speedy and works almost as fast as you can write.

The handle is made by wrapping a piece of sheet asbestos around a pencil so as to form a tube about 4½ in. long and of ½-in. diameter. Use water glass (sodium silicate) for a cement. Wrap a 1-in. strip of asbestos around one end to make a finger grip, half of it projecting beyond the handle tube so as to provide a space for the connectors into which the hot tips are to be inserted. Allow the handle to dry throughly before finishing it with enamel or lacquer. Constructed in this way, it is practical and safe, forming an insulation against both heat and electricity.

After passing the connecting cord through the handle, wind the bare ends around a No. 16 copper wire to form small coils, as shown in Fig. 2. These are the hot-tip connectors. Wrap them with asbestos and hold inside the finger grip with a putty made of asbestos and water glass.

The tips, which are very easy to make, consist of short pieces of nichrome wire (which can be taken from a heating coil), bent as desired and with the ends attached by crimping to short pieces of No. 16 wire. A V-shape tip will be found most useful for general work, while loops, squares, and other shapes are suitable for background work and for repeating a design a number of times.

Figure 6 shows the resistance unit into which the cord from the pen is plugged. It is merely a nichrome heater coil cut into one side of the current supply. Remove several inches of wire from the coil if you desire to have the pen tips glow white hot. The ordinary red heat is usually sufficient, however, unless hardwood is to be decorated.

When wood-burning designs call for a number of circles, a good kink is to make up a very short tip holder and attach it to a compass, as in Fig. 3, so that perfect circles of any size can be burned. A special tip for burning your initials on the wood handles of tools can be made by forming the nichrome wire around brads driven into a block of wood, as in Fig. 4. Any other small design or figure can, of course, be made in the same way.

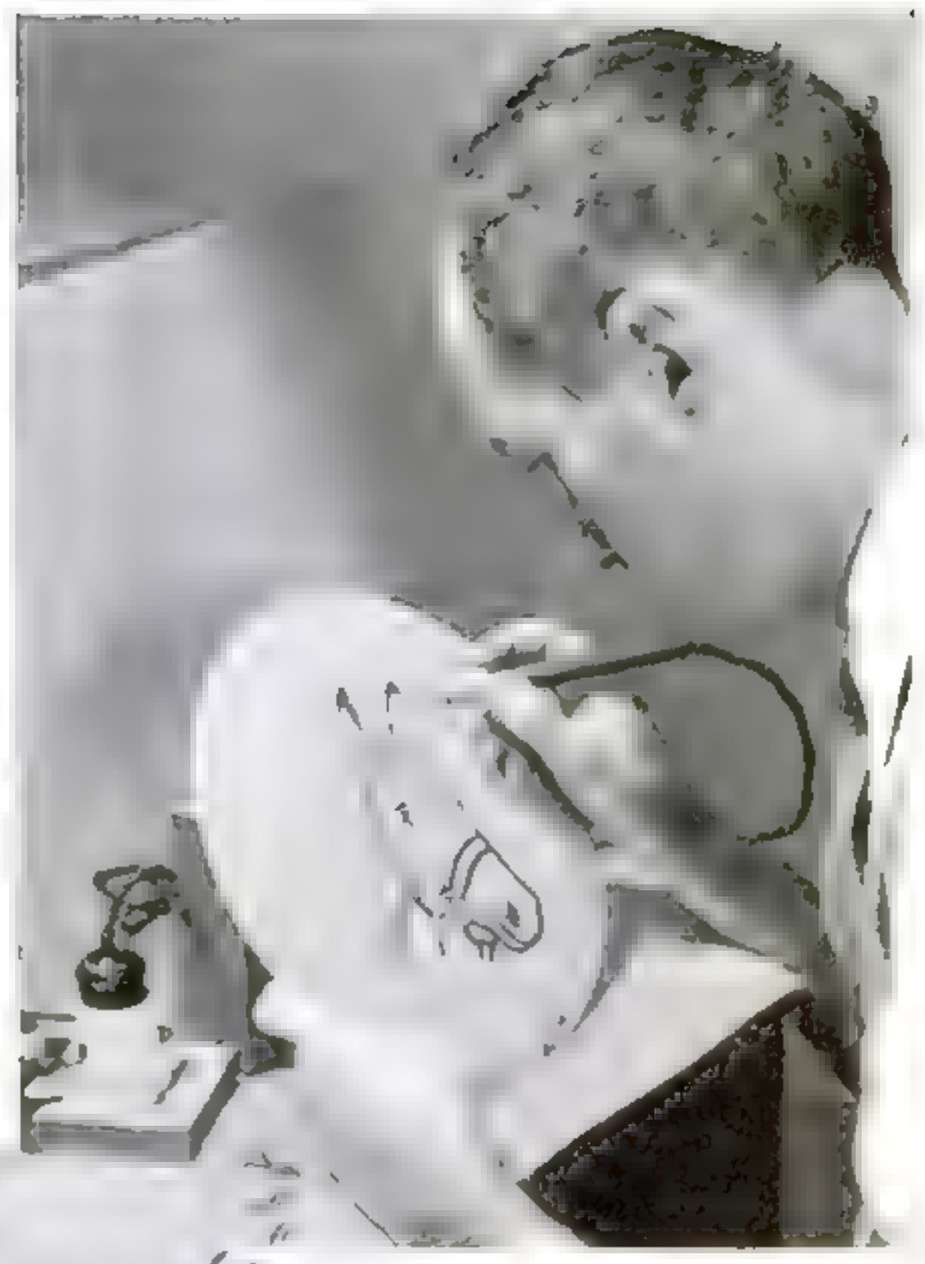


Fig. 1. Heated electrically by the ordinary house current, this easily made pyrographic pen can be used for a variety of decorative work

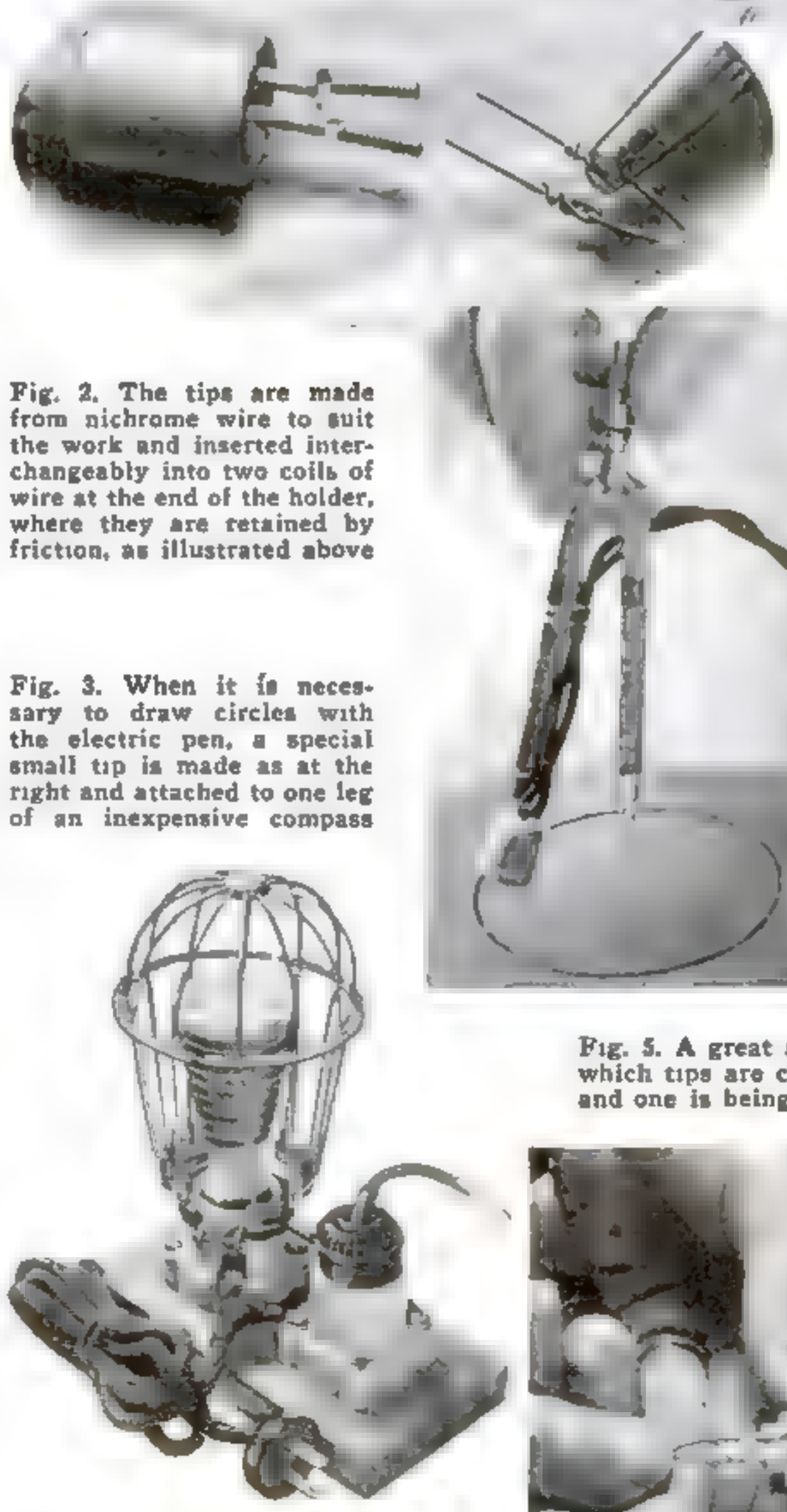


Fig. 2. The tips are made from nichrome wire to suit the work and inserted interchangeably into two coils of wire at the end of the holder, where they are retained by friction, as illustrated above

Fig. 3. When it is necessary to draw circles with the electric pen, a special small tip is made as at the right and attached to one leg of an inexpensive compass

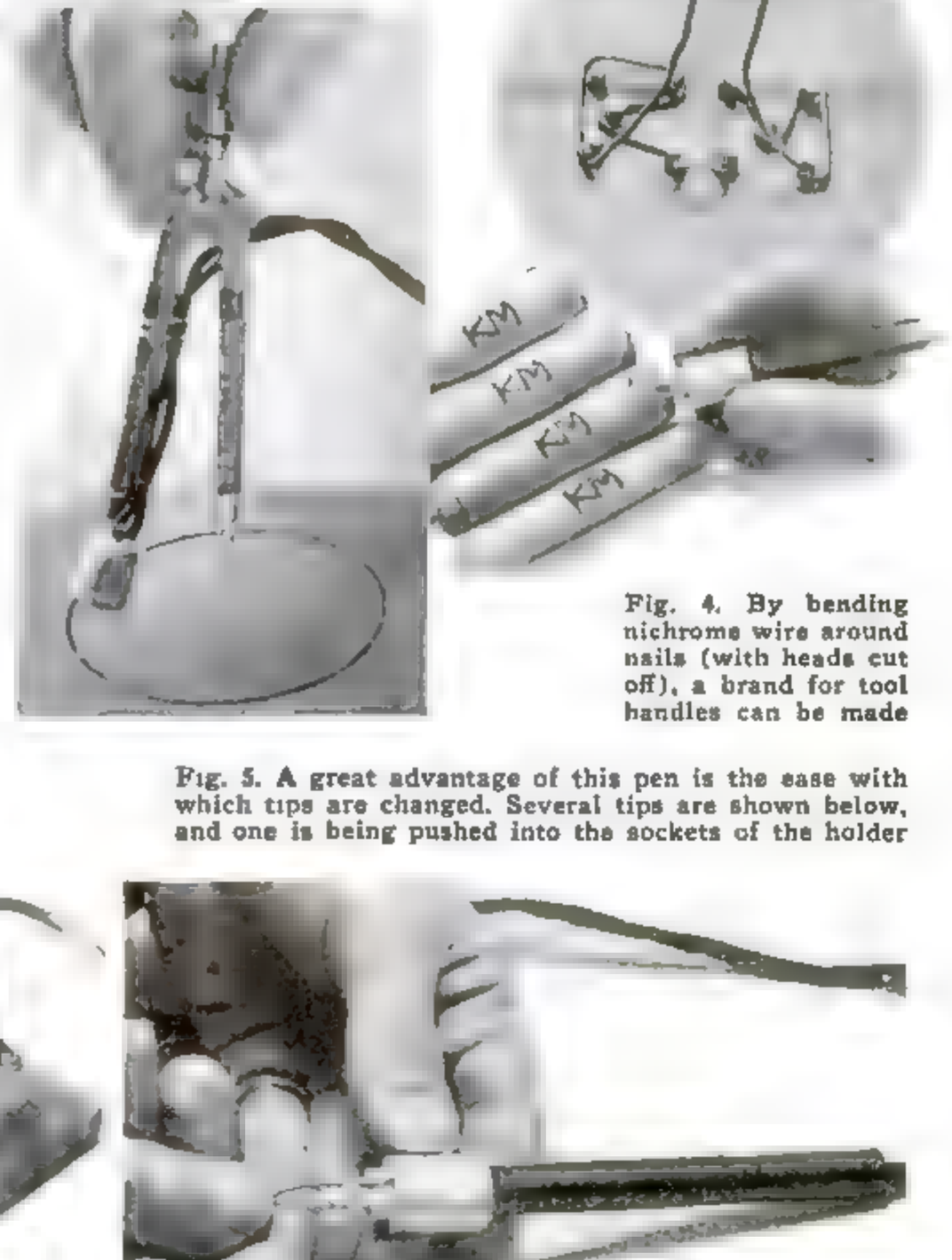


Fig. 4. By bending nichrome wire around nails (with heads cut off), a brand for tool handles can be made

Fig. 5. A great advantage of this pen is the ease with which tips are changed. Several tips are shown below, and one is being pushed into the sockets of the holder

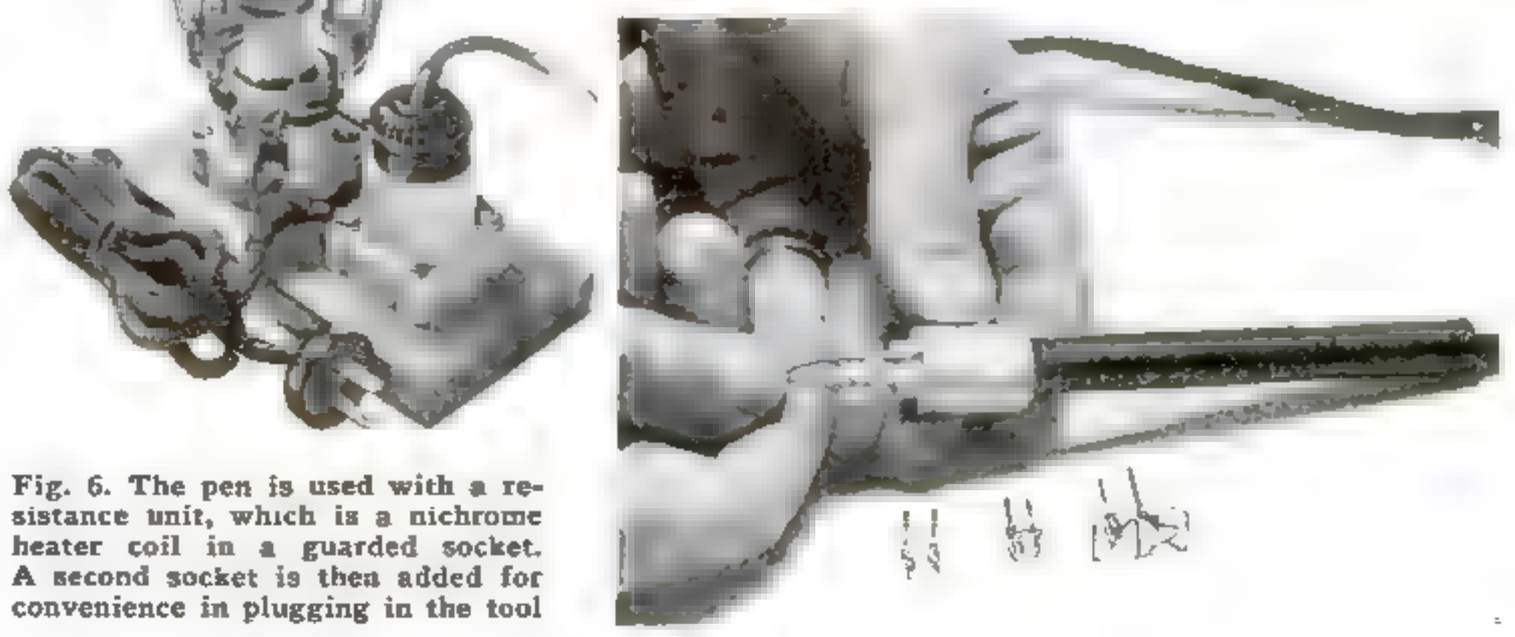
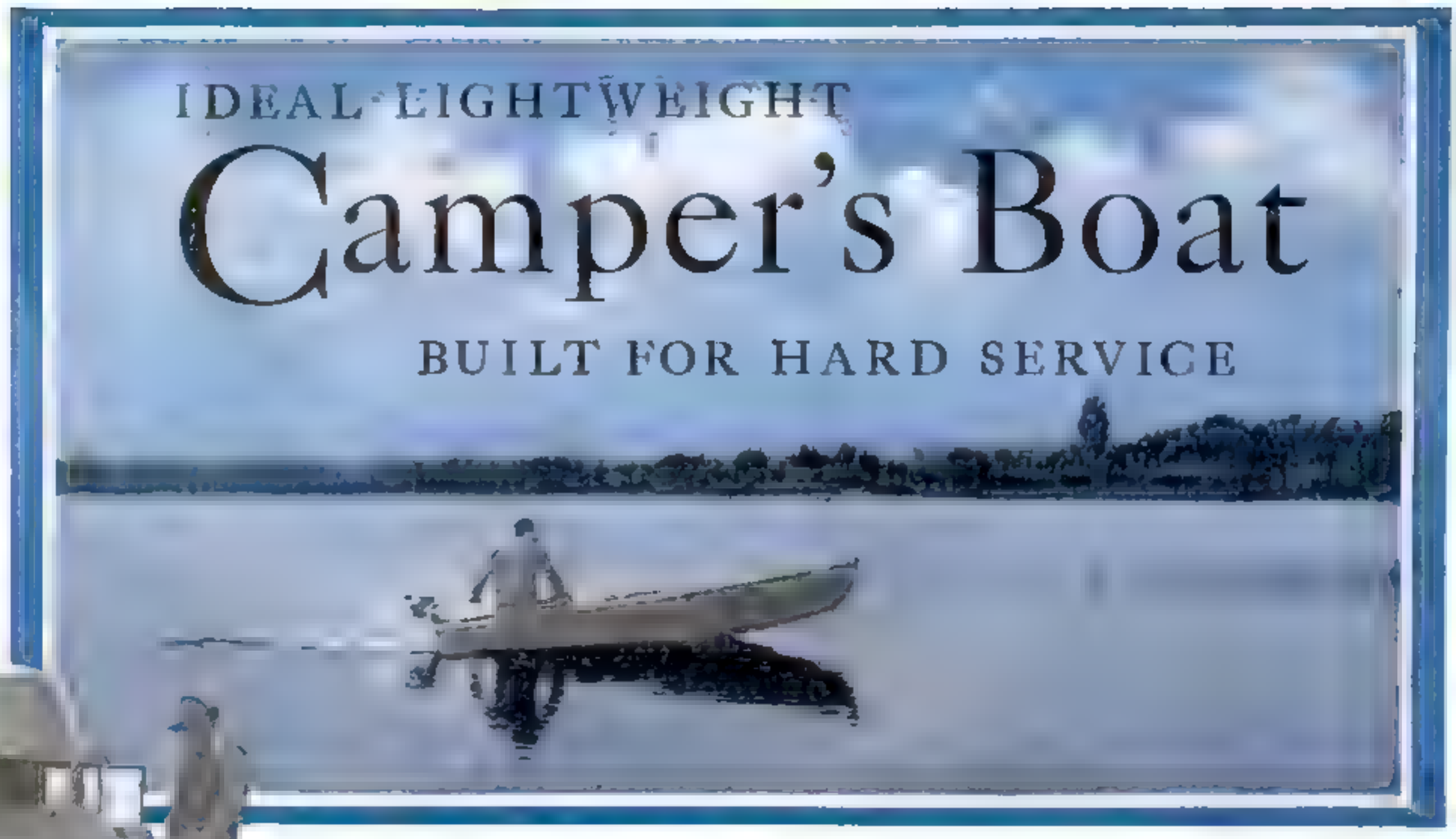


Fig. 6. The pen is used with a resistance unit, which is a nichrome heater coil in a guarded socket. A second socket is then added for convenience in plugging in the tool

IDEAL LIGHTWEIGHT

Camper's Boat

BUILT FOR HARD SERVICE



For leisurely cruising or trolling, a small outboard of two horsepower will provide sufficient speed. A motor of fourteen horsepower will drive it up to about thirty-five miles an hour. The boat weighs so little that two men can raise it without difficulty on top of a car, and one man can get it on a low trailer

WANDERER is an ideal canvas-covered boat for camping, fishing, and pleasure trips. It is 11 ft. 2 in. long, just under 4 ft. in beam, and weighs about 100 lb. Although designed for two, it will carry four persons safely. Light in weight for its unusual carrying capacity, the boat may be easily transported afloat or ashore. Two men can raise it on top of a car, or one man alone on a trailer.

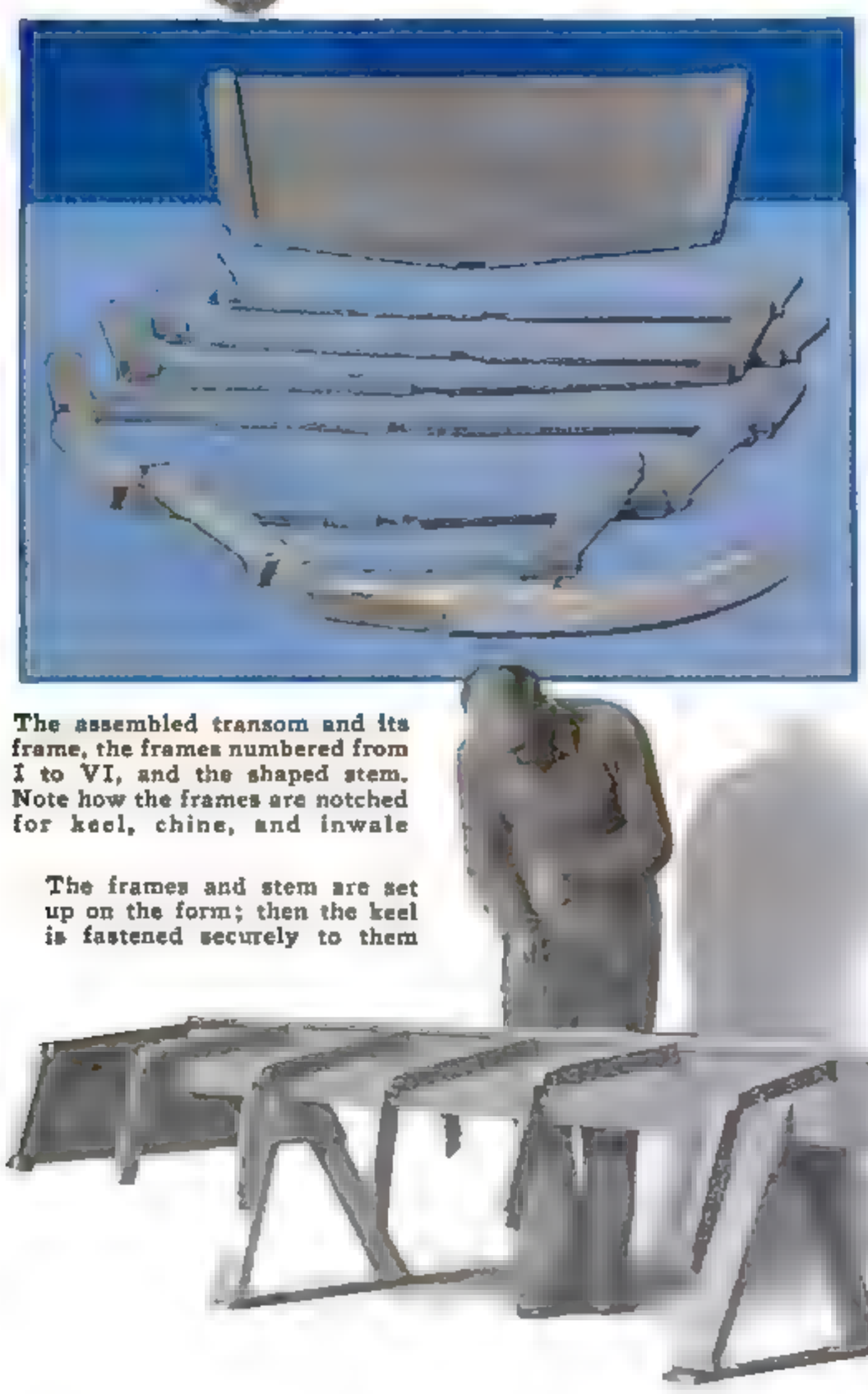
Speeds up to 35 miles an hour are attainable with a motor of 14 horsepower, while a small motor of 2 horsepower will give good trolling and cruising speeds. Because of the modified V-bottom, *Wanderer* responds quickly and easily to oars, and is seaworthy and safe in rough or fast water.

The canvas covering keeps the hull permanently water-tight without bothersome swelling or leaking, even when it is left exposed to the sun and hot winds or is stored away for a time. The filler coat effectually seals the cloth, providing a smooth, frictionless, and water-proof finish. A coat of paint each year will keep the hull in perfect condition. Tears in the fabric will not cause leakage and may be repaired by applying a piece of cloth coated with canvas cement.

The cost of materials is about $18 or $20, but will vary to some extent according to the locality. Standard lengths of lumber are used, and it may be ordered cut to size at any mill. The low finished weight depends upon the selection of lightweight materials. Spruce or hemlock is preferable for framing, although the lighter weight varieties of fir may be used. For planking, it is best to use cedar, spruce, or white pine, with redwood as second choice. In addition to ordinary carpenter's tools, a half dozen or more of 6-in. C-clamps will be required.

The first step is to saw the form upon which the boat is to be built from a common 2 by 8-in. plank, 10 ft. 2 in. long. Cut notches for the frames and attach legs similar to those of a sawhorse at a convenient height.

The plans have been drawn with great care, but to avoid mis-



The assembled transom and its frame, the frames numbered from I to VI, and the shaped stem. Note how the frames are notched for keel, chine, and inwale

The frames and stem are set up on the form; then the keel is fastened securely to them

A close-up of the stem is given at the right to show how to fasten to it the inwale, chine, and batten. The latter is placed so as to back up the planking joint

Simple to construct and easy to transport, it can be rowed or driven by an outboard motor of any size . . . Has canvas covering

By WILLIAM JACKSON

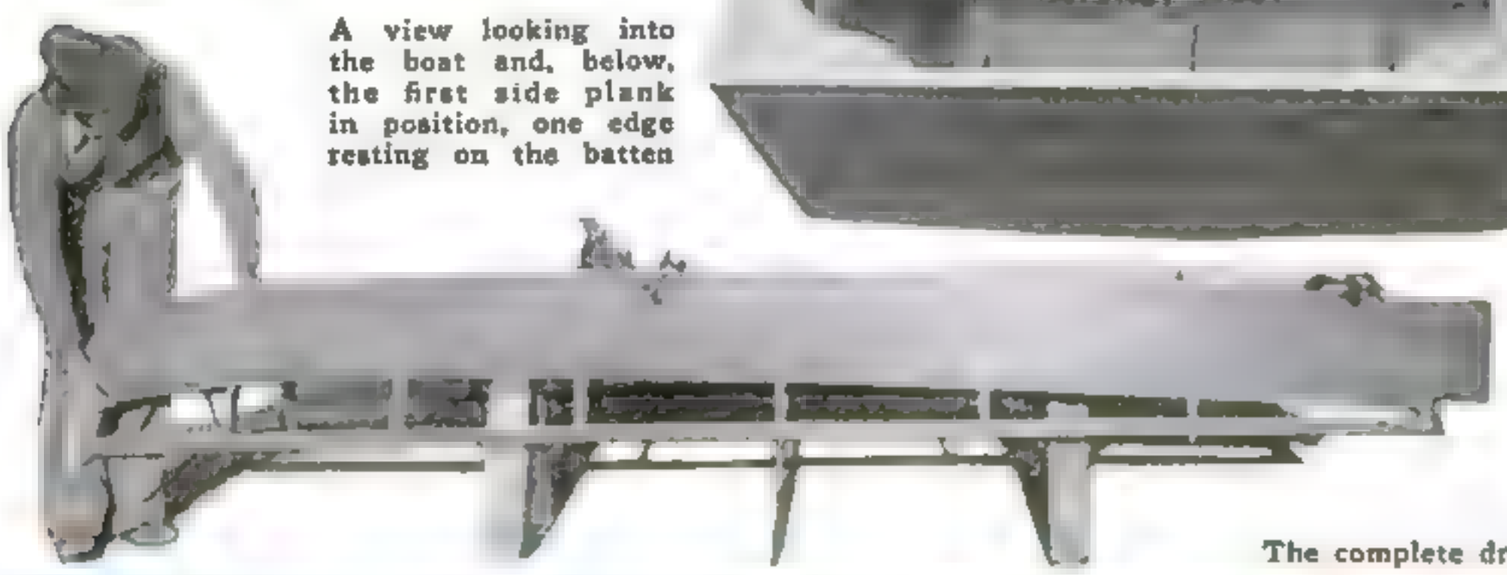
Boating Editor of "Outdoor Life"

Because of its design, the boat is seaworthy and responds well to oars

takes, to insure fair lines, and also to gain a more comprehensive idea of the boat as a whole, you should lay out the plans full size on large sheets of wrapping paper, previously tacked down on a smooth floor. Patterns of the stem, knees, and breasthook may be taken from the full-size drawing.

After the lines have been laid out full size, drawings of the frames are made on other large sheets of paper. The outlines of the various frames, both the side and the bottom pieces, are marked upon the frame material, preferably by pricking through with a toothed marking wheel, and then sawn to shape and trimmed. Leave the top edges of frames Nos. 1, 2, and 3 wider at the top edge by ½ in. to allow for trimming later on.

Lay the side and bottom members on the full-size patterns so as to conform to the outline, and fasten together with two ¼ by 1¼-in. carriage bolts to each joint. The two 8-in. wide transom boards are merely butted together, secured with a frame as shown, and fastened with 1¼-in. No. 8 screws. All screws must be brass or galvanized iron and flat-headed.

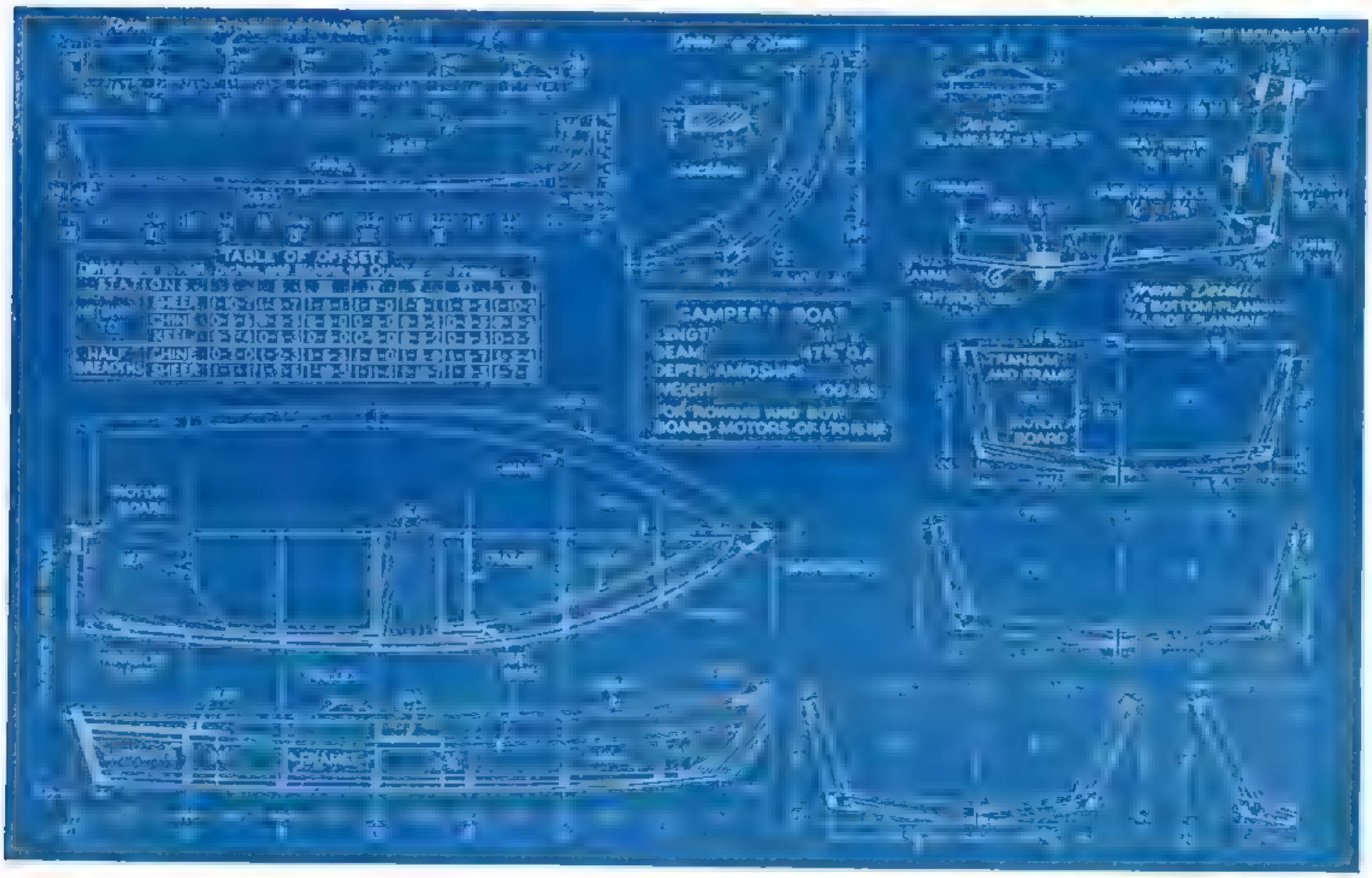


A view looking into the boat and, below, the first side plank in position, one edge resting on the batten

The assembled frames are temporarily fitted into the form notches. A light batten sprung around the frames will show the bevel to which the sides must be cut so the planking will lie evenly. Mark this bevel, remove the frames, and trim them. The notches are now cut for the inwales, chines, and keel.

The bow-stem pattern is transferred to the stem material, sawn to shape, beveled, and trimmed. Using a piece of ¼-in. planking as a gauge, cut the rabbet ¼ in. strong to allow for trimming. The planking goes into this rabbet at the same angle from top to

The complete drawings and a check list of offsets are given below



List of Materials

LUMBER

No. of Pieces	Description	T.	W.	L.
2	Side planking	¼ in.	8 in.	12 ft.
2	" "	¼	10	12
2	Bottom planking	5/16	12	10
1	" "	5/16	10	16
1	Frames	¾	10	14
1	Transom	¾	8	8
2	Chines	¾	1¼	12
1	Keel	¾	2	10
2	Clamp	½	1½	12
2	Inwale	⅜	1½	12
4	Battens	⅜	1½	12
2	Seat risers	¾	1½	12
1	Seats	¾	12	12
1	Seat supports	¾	4	4
1	" "	¾	1½	4
2	Sheer molding	½	1	12
4	Floor boards	⅜	4	8
1	Oarlocks	2	4	2
1	Stem	2	8	2
1	Transom knees and breasthook	1¼	10	2
1	Outside keel	½	1	10
1	Form	2	8	12

NOTE: Use spruce, hemlock, or lighter varieties of fir for all except the planking, which should be cedar, spruce, white pine, or redwood, and the form, which may be any rough lumber.

MISCELLANEOUS

Screws, brass or galvanized: 5 gross of 1-in. No. 8; 26 of 2-in. No. 10; 50 of 1¼-in. No. 10; ½ gross of 1¼-in. No. 8.

Carriage bolts, galvanized: 24 of ¼ by 1¼-in. and 4 of ¼ by 3½-in.

½ lb. 1-in. clout nails (copper for salt water, wrought iron for fresh water).

¼ lb. 5/16-in. tacks, copper or galvanized iron.

8 yd. canvas or heavy laundry-mangle muslin, 36 in. wide.

1 gal. canvas cement.

1 qt. paint of desired color.

1 qt. high-grade spar varnish.

1 pr. 6½-ft. spruce oars.

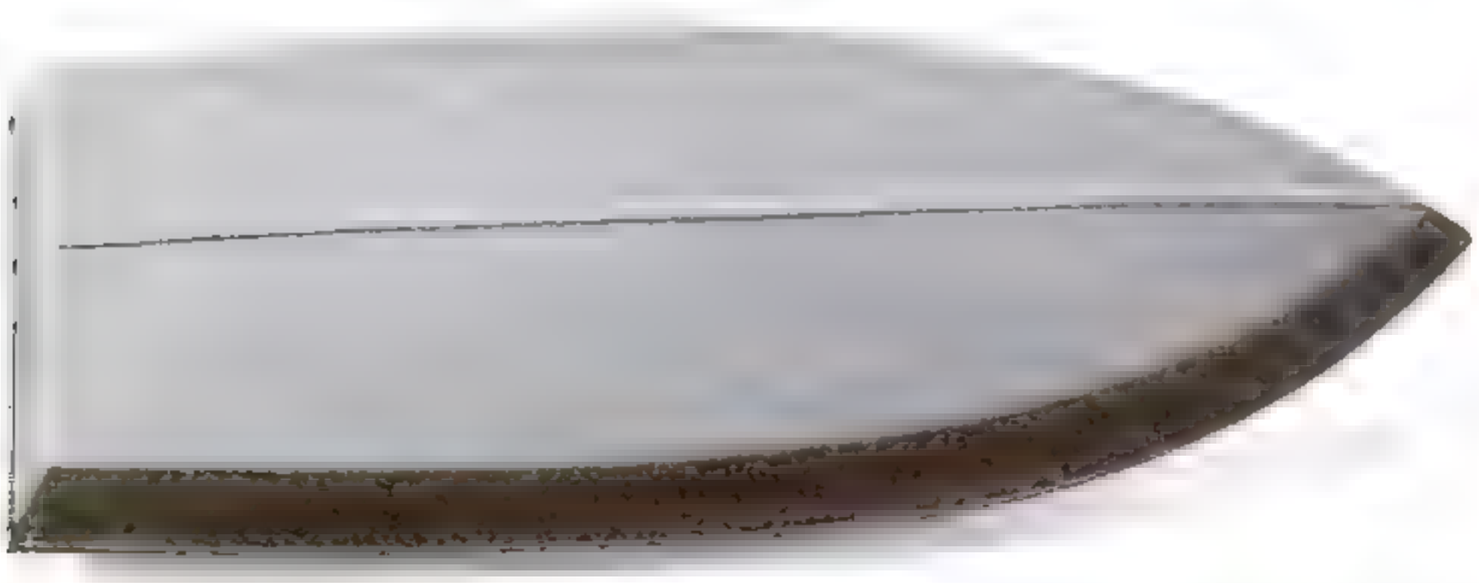
bottom of the stem (see stem detail).

Assemble the frames on the form in their respective notches. Attach the keel to the frames and stem with two 1¼-in. No. 10 screws to each joint. A few screws will suffice to hold the keel temporarily to the form.

Line the frames up squarely and attach both chines simultaneously. Fasten them in each chine notch with one 2-in. No. 10 screw. At the stem, bevel the edge of the chines to fit flush against the keel and fasten with a 1¼-in. No. 10 screw.

Next secure the inwales with one 1-in. No. 8 screw to each joint. Bevel the ends of the inwales to fit flush against the stem and attach them with two 1-in. No. 8 screws.

The entire frame must now be faired, all uneven joints being trimmed flush so



The smooth appearance of the bottom of the finished boat can be judged from this photograph. An outer keel is applied over the canvas to prevent it from being abraded or worn off along the keel

The canvas covering is placed on the hull in two pieces, with the seam in the center. It is fastened securely with canvas cement

the planking will lie evenly throughout.

The ¼ by 10-in. lower side planks are clamped to the sides, and the frames marked along the outside edge. Remove the planks and notch battens into the frames so the plank edges will meet in the center of the batten. Fasten the battens to each frame with one 1-in. No. 8 screw. Bevel the battens to fit flush and fasten them similarly at the stem.

SHAPE the ends of the side planks to fit the stem rabbet, and clamp to the sides, one edge in the center of the batten. Fasten the planking to the frames, chines, and stem with 1-in. No. 8 screws, spaced about 3 in. apart. Countersink the screws along the chines so that the chine edge may be beveled later. Fasten the planks to the battens with 1-in. wrought-iron clout nails, spaced 2½ in. apart and clinched on the inside. Fasten the upper side planks similarly, clout nailing the edges to the battens and inwales. Drill lead holes for all nails and screws.

Trim the planking along the chines so the bottom planking will lie evenly, and attach the center bottom planks. From frame No. 2 to the stem, the edges of the center planks will require fitting. Mark a center line on the keel. Trim the plank edges until the plank from transom to stem follows the center line. With the two center planks fitted, mark the frames along the outside edge of the planks. Remove the planks and cut notches for battens so that each plank mark comes in the center of a batten notch. Attach the battens with 1-in. No. 8 screws.

Clamp the two center planks in place and fasten them to frames, keel, and chines with 1-in. No. 8 screws spaced 3 in. apart. Clout nail the planks along the battens, spacing the nails every 2½ in. When fastening the two remaining planks, insert the frame fastenings first; then plane the planks flush along the chine. Insert the chine fastenings as near the inside edge as possible. When the chine edge is rounded off, undue wear of the cloth covering is prevented at this point.

Turn the hull over and fasten in the transom knees and breasthook. Drill lead holes and fasten with four 2-in. No. 10 screws to each knee and hook.

The ½ by 1½-in. clamp pieces are clamped in place, and the top edges of frames Nos. 1, 2, and 3 are trimmed to fit flush against the clamp. Fit the ends in the breasthook and knees, and fasten with one 1¼-in. No. 8 screw to each joint.

Fit the ¾ by 1½-in. seat risers in place, slightly notching the lower edge into the frames. Fasten them with 1¾-in. No. 10 screws.

The hull is now ready for the cloth covering of 8-oz. canvas or heavy muslin such as that sold for laundry mangles. A standard grade of canvas cement is used to attach the cloth to the hull.

FIRST plane the edges of the planking round along the chines, and round the edges at the transom. Plane and sand the entire hull smooth, as the smoothness of the finished surface depends upon a smooth, fair hull. Plane the keel seam flat so the outside keel will fit evenly.

As the cloth will be placed on the hull in two pieces, with the seam in the center, first stretch a length of cloth in place so that it covers the side and half of the bottom. It will be found that the cloth will overlap considerably at the forward and after keel seams, and overlap about an inch amidships. When it is seen how the cloth will best stretch without wrinkles, remove it and apply a uniform coating of canvas cement with a wide brush on the half of the hull to be covered.

Stretch the cloth in place, allowing 2 in. to overlap at the transom and about 1 in. along the keel seam. Work the wrinkles out by stretching and tacking. As the work progresses, rub the entire surface of the cloth with a block of wood to which has been attached a piece of inner tube, to insure complete adhesion of the cloth to the planking. Tack along the keel seam, transom, top edge of planking, and stem.

Attach the other side in similar fashion, allowing an overlap of 1 in. along the keel and 2 in. over the transom edge. Trim the overlap at the transom, and glue and tack the cloth in place. Cut a piece to conform to the shape of the transom, coat the transom with glue, and tack the cloth, rubbing the surface to *(Continued on page 103)*

New Trellises
TO DRESS UP YOUR GARDEN

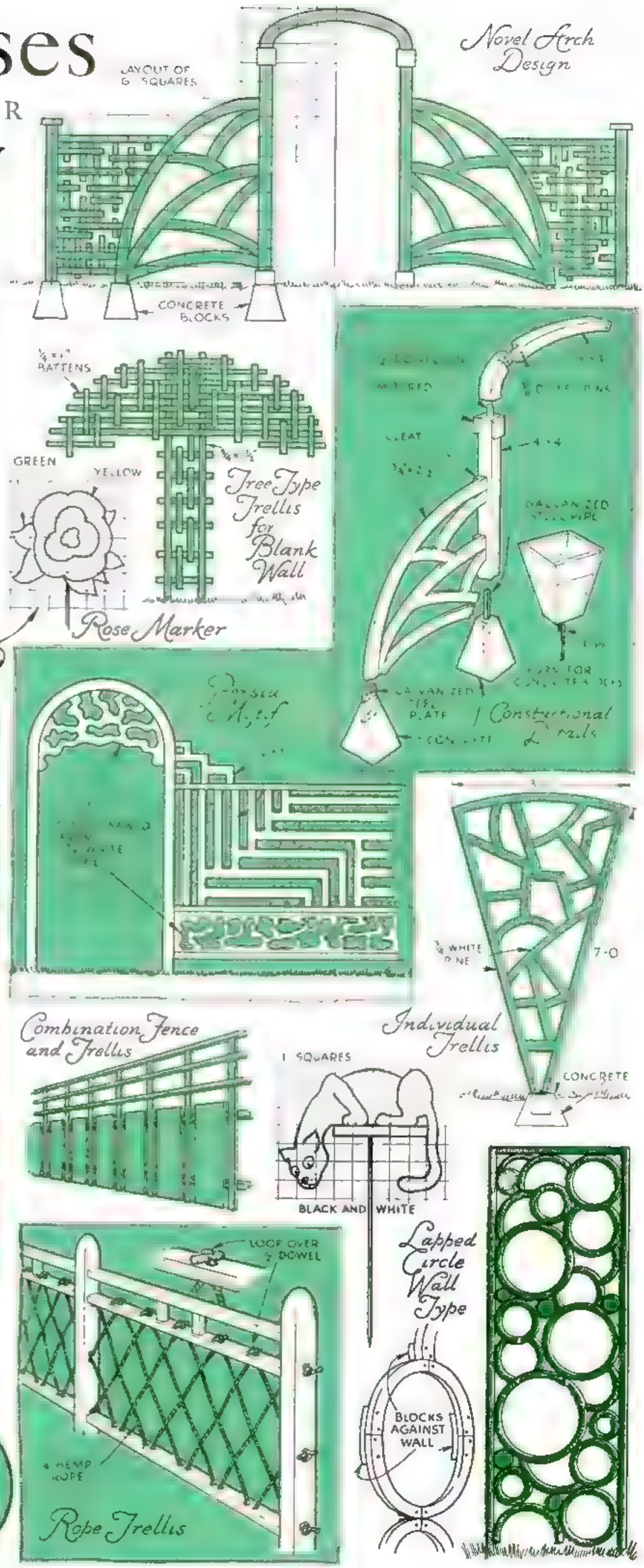
By Hi Sibley

LOOK around your garden this spring and see if one or more new trellises would not improve it greatly. If so, here are some suggestions that may help you work out something at once original and decorative. These designs are a departure from the familiar rectangles, squares, and compass curves of ordinary commercial trellises.

White pine is an excellent wood to use, especially for scroll-sawed pieces, because it is not likely to split and lends itself to the use of corrugated fasteners for holding butt joints. Plywood should be avoided unless of the water-resisting, casein-glued type, and even then the surfaces and particularly the edges should be thoroughly painted.

The arch design at the top of the accompanying drawings is a novel arrangement of curved pieces cut from white pine, with an irregular pattern on each side. This type, when not against a wall, can be left in the natural wood to weather. The posts will last much longer if supported on small pyramids of concrete with pipe or flat plates embedded. The concrete is poured in an inverted form as shown.

Another unusual trellis and gateway is the Persian design. The upper panels are in a basket-weave effect, built up of battens. A short piece is put behind each right-angled joint.



HAMMERED COPPER

Bud-Vase Holder

By KENDALL FORD

THIS hammered copper bud vase, which is an attractive piece for the table or mantel, can be made by the amateur craftsman with a few hand tools in an evening's time.

Cut two 4-in. square pieces of soft sheet copper, 20 or 22 gauge. Hammer one side of each piece with the round end of a ball-peen hammer, placing the marks close together and working from the center outward. If the copper becomes springy and tends to curl up, it may be softened by holding it over a flame until it turns black and then plunging it quickly into cold water.

Find the center of each piece and scribe a circle 4 in. in diameter. Scribe two additional circles on one of the pieces, 3 and 3⅝ in., as shown in Fig. 1 of the drawings. Cut each piece around the outside circle.

Place one of the pieces, which is to serve as the base, over a rounded hole in a block of wood, the hole being about 3½ in. in diameter. The hammered side should be turned down over the hole. Raise the center by beginning to hammer at the 3-in. circle and gradually working toward the center. This operation will have to be repeated several times until the desired shape and depth are obtained. Do not attempt to do this in one operation because the hammer may break through the copper. In order to keep the copper soft and pliable, it will be necessary to soften it occasionally as described before. The hammer shown is the type commonly used for removing dents from automobile fenders, but the flat face of an ordinary ball-peen hammer may be used if the edge is rounded slightly to avoid cutting the metal.

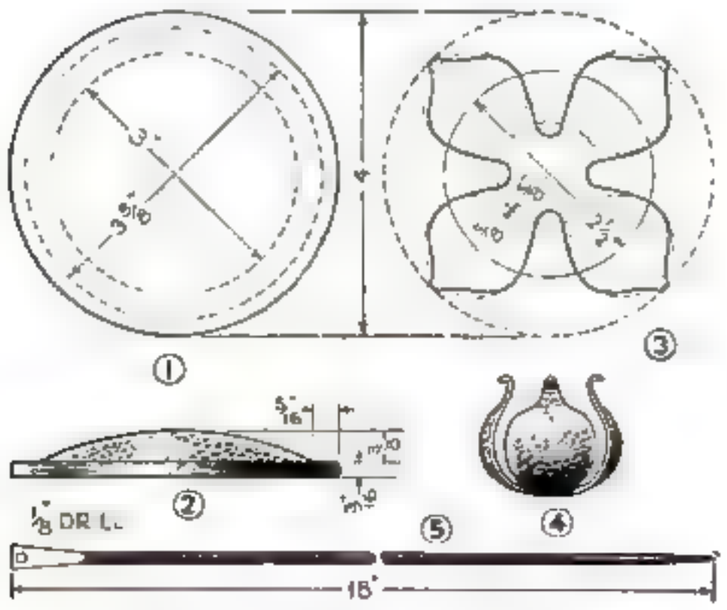
Turn the edge of the base as shown by placing it over a circular piece of steel or hard wood. Figure 2 gives the shape of the completed base.

The disk for the base is placed over a hole in a block of wood and hammered gradually to give it the desired raised form

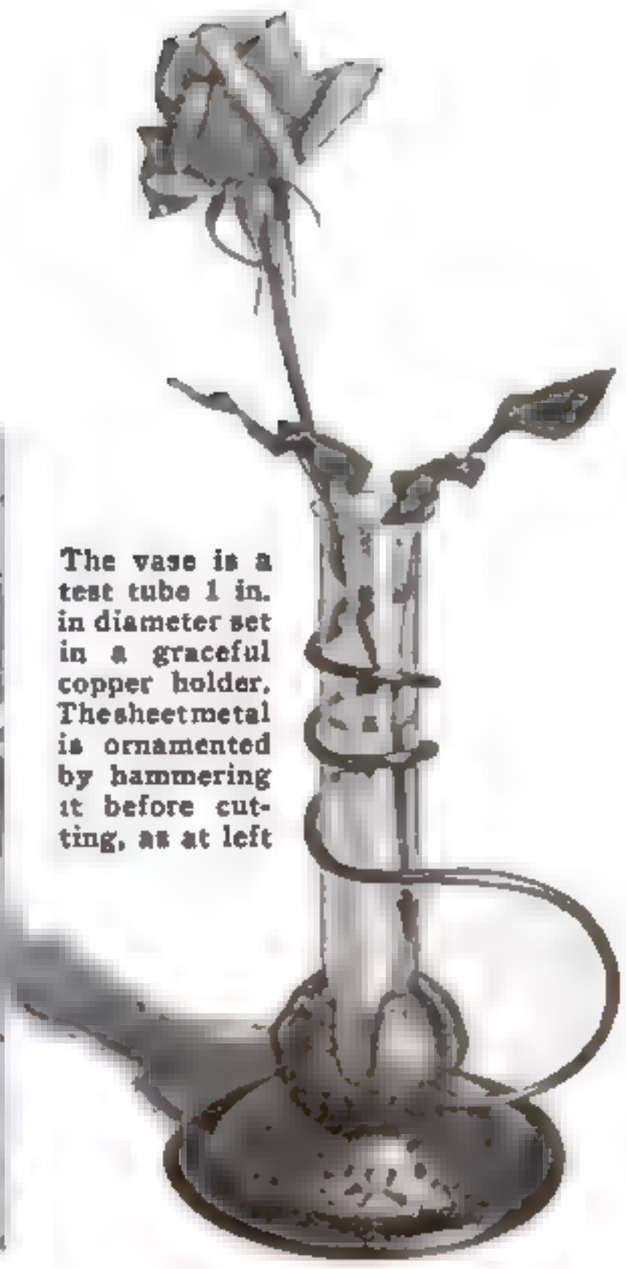
To turn the edge of the base, the metal is held over a circular block of wood or steel

Cut the remaining piece of copper to the shape outlined in Fig. 3. If four 5/16-in. holes are drilled through the copper where the sections join, ⅝ in. from the center, the cutting to shape will be a simple job. Flatten the end of a piece of No. 8 copper wire, or ⅛-in. copper rod, and drill a ⅛-in. hole about 3/16 in. from the end. Taper the opposite end as shown in Fig. 5.

Drill a ⅛-in. hole in the center of the base and the four-leaf holder. Give each of the four sections of the holder itself a graceful concave form by placing the hammered side on a block of soft wood and shaping with the ball end of a ball-peen hammer. Bend the holder to the shape shown in Fig. 4 and rivet it to the base, with the copper wire in between. The distance between the tops of the sections will depend upon the diameter of the test tube used. The one used by the author is 1 in. in diameter and 6 in. long. Bend the copper wire around the test tube as illustrated above.



How to lay out the stock for both pieces of the base, and sketches of the finished parts



The vase is a test tube 1 in. in diameter set in a graceful copper holder. The sheet metal is ornamented by hammering it before cutting, as at left

The completed holder may be simply polished with steel wool and lacquered, or a very pleasing finish may be obtained by immersing it in a solution of potassium sulphide and water and polishing off the high spots with steel wool after the holder is dry. The length of time to leave the article in the solution may be determined by the color desired. Potassium sulphide loses its strength when exposed to the air, so no definite proportions well be given here. A piece about ½ in. in diameter dissolved in a quart of water should prove satisfactory.

HOW TO WIELD A GLASS CUTTER SUCCESSFULLY

IN USING a glass cutter, the glass should rest in perfect contact with its supporting surface—for example, a bench or table well padded with newspapers. Place the hollow side of the glass down if there is any noticeable difference. Hold the cutter vertically, use a firm, steady pressure, and make one cut only. If the glass does not break easily, tap lightly with the cutter holder along the cut on the under side of the glass, or rest the cut over any convenient straight edge and break the piece off with gentle pressure.

When it is necessary to cut an outside curved edge, lay the glass over the desired curve drawn on a piece of paper, make several cuts, say ½ in. apart outside of the curve, and break the glass away. Now make the final cut over the curve. If an inside curve is being cut, make the correct cut and another, say 3/16-in. inside of it. Then make V-cuts in the waste glass and break the glass away with the slots in the cutter handle or with flat-jawed pliers, unless it breaks away easily otherwise.—CHARLES A. KING.

BEAUTIFUL OIL-RUBBED Pipe Case

Made from Old Cigar Box

By IVAN C. LUCKMAN

In richness of finish, this piece equals the dueling-pistol case it was designed to match

EVERY pipe smoker wishes from time to time for a case that will hold his best pipes so that they will not become nicked or scratched. A case similar to the one illustrated, which was designed to hold three pipes, can be made for four or five pipes, if necessary, without increasing the dimensions of the box.

The box is an empty cedar cigar box. Be sure it is made of cedar; if of cull wood, it cannot be finished properly. Plane or scrape the printed matter very thoroughly from its sides and top. If it is inconvenient to get a cedar panel to hold the pipes, this piece may be of any wood with a distinctive or pleasing grain. A piece of thin plywood will probably be better than a solid panel because it will not be so likely to warp.

To prepare a template, cut a sheet of white paper to the exact dimensions of the panel and place it directly under a shaded light. Place the pipes in their proper locations and trace the outlines of their shadows carefully on the paper. If the light is squarely over the pipes and not too far away, the outlines will be just right to clear the pipes easily after the openings have been cut into the panel.

Next make a sufficient quantity of paper pulp by tearing newspapers into very small pieces and boiling them in water until you have a plastic mass. Squeeze all the water possible from this mass and allow it to dry partly.

Cover the inside of the box with at least two coats of shellac, working it thoroughly into all the cracks and joints. If the box is not made waterproof, it will warp from the drying pulp. After the shellac has dried, apply another rather thick coat of shellac and line the box with a loosely crumpled layer of newspaper, sticking it in place around the edges with the shellac. Do not cover the uppermost side of the paper with the shellac. The purpose of this paper lining is to provide a wrinkled surface to act as an anchor for the pulp.

Fill the box to within about ½ in. of the top with the pulp, and work the pulp into a solid mass by using a small block for a tamper. After the pulp has been leveled parallel with the top of the box, place the template or the panel temporarily in place to locate the pipes. Each pipe should be covered with wax paper or other waterproof wrapping material before it is placed in the wet pulp. Force the pipes down into the pulp for about half their width. They can be removed at once after the mold has been formed. Allow the pulp to dry without too much heat. After the pulp has dried, cover its surface, with the exception of the recesses for the pipes, with glue and press the panel in place.

Tracing the shadow of a pipe on paper to be used as a template for cutting out the panel

Each pipe is covered with waterproof cigarette-wrapping material and pressed firmly into the moist bed of paper pulp

As an alternative method, the panel may be dispensed with and the pulp covered with velvet or felt. If you use velvet, obtain the quality known as "jeweler's velvet," which is a very thin, reasonably priced fabric that will not be too bulky where it is necessary to use a double thickness in the recesses. Also, if velvet or any other fabric is used in place of the wood panel, it will be necessary to move each pipe both endwise and sidewise when the mold is still wet in order to provide the necessary clearance.

The case can be finished by any method that will preserve or accent the grain of the wood. The model illustrated, which was made to match a very old dueling-weapon case, was finished with oil. This method, while laborious, results in a perfect finish.

Obtain some pure raw linseed oil—a pint will be more than ample—and allow it to heat just short of the boiling point for half of an hour. After it has cooled, add two ounces of pure turpentine to each pint of oil and strain through flannel. The mixture is applied to the wood with a rag and rubbed across the grain with a heavy pad such as three or four thicknesses of old carpet. The applications and rubbing should be continued three or four times each week for at least two months to get the finest appearance. The surface should be washed with water each time it is worked on. Theoretically, such a method of finishing is never completed; its beauty increases with each application. This is one of the best methods of reproducing or matching an antique finish.

Be very careful of the rags and pads between times, because the mixture of oil and turpentine may ignite the rags from spontaneous combustion. It is best to keep them in a fireproof container.

The inside of the lid is lined with a piece of colored velvet or cloth.

A pipe case, so assembled, provides a comparatively soft socket for each pipe, and the pulp-and-wood construction will not hold the odors of stale tobacco.

MACHINING CAST RESINS

THE commercial machining of cast plastics, or more properly cast synthetic resins, is best done with tools of stellite, tungsten-carbide, and tantalum-carbide rather than tool steel. As in cutting wood or ivory, a negative rake should be used to prevent "biting."—IRA S. WILLIAMS.

SAVE time by using our simplified construction kits, listed on page 84.

FROM THE

Home Workshops *of Our* Readers

A fully framed scale model of an early nineteenth century British East Indiaman by A. F. Crabtree, of Portland, Ore., who was once a shipyard worker. Every piece is exactly as in the original ship. The deck planks, for example, are separate pieces. The blocks are only ⅛ in., but they have working sheaves. All parts actually work, including wheel and rudder

Hydrocycle constructed from an old bicycle by J. K. Vartabedan, of Beirut, Syria. He removed the wheels, cut away the unessential parts of the frame, and bent the tubular rear-wheel fork downward about 30 degrees. The fork was spread to make room for a four-blade paddle wheel with sheet-iron blades 2¾ by 12 in. screwed to two wooden blocks, which were bolted around a rear hub of the noncoaster type. The light pontoon frames are covered with galvanized iron

This side of the hull is planked, but the other was left unplanked below the wales so the microscopically perfect interior details could be seen through the frames

Mark Pennington, of Kingston, N. Y., who started as a model maker by building our early ship models, made this extraordinary ¼-in. scale model of an eighteenth century colonial courthouse. It is of carved plaster of Paris with 2,200 separate shingles. The stocks are hinged and have a hasp and padlock. The child's toy wagon is only ⅜ in. from end to end, including the tongue, yet is built of separate pieces

Fifteen-year-old Herbert W. Hutchison, of Camden, N. J., built this kayak and carriage. The kayak is 12 ft. long, weighs about 100 lb., and is remarkable in that the hull is covered with sheet copper. The deck is of a pressed-wood composition board, which resembles mahogany when varnished. The carriage is made from old pieces of ⅜-in. iron pipe, a few fittings, two pipe unions, and discarded wheels

A racing outboard motor boat *Scram* is shown at the left. It was built by W. R. Monroe, of Sweetwater, Texas, from plans published in *Popular Science Monthly*. "This is a sweet little craft," Monroe writes, "and its performance is very much underrated by the designer." The boat is 10 ft. 4 in. long over all, has a beam of 46½ in., and weighs 114 lb. fully fitted

Stage Sets *and* Scenery
for MARIONETTE SHOWS

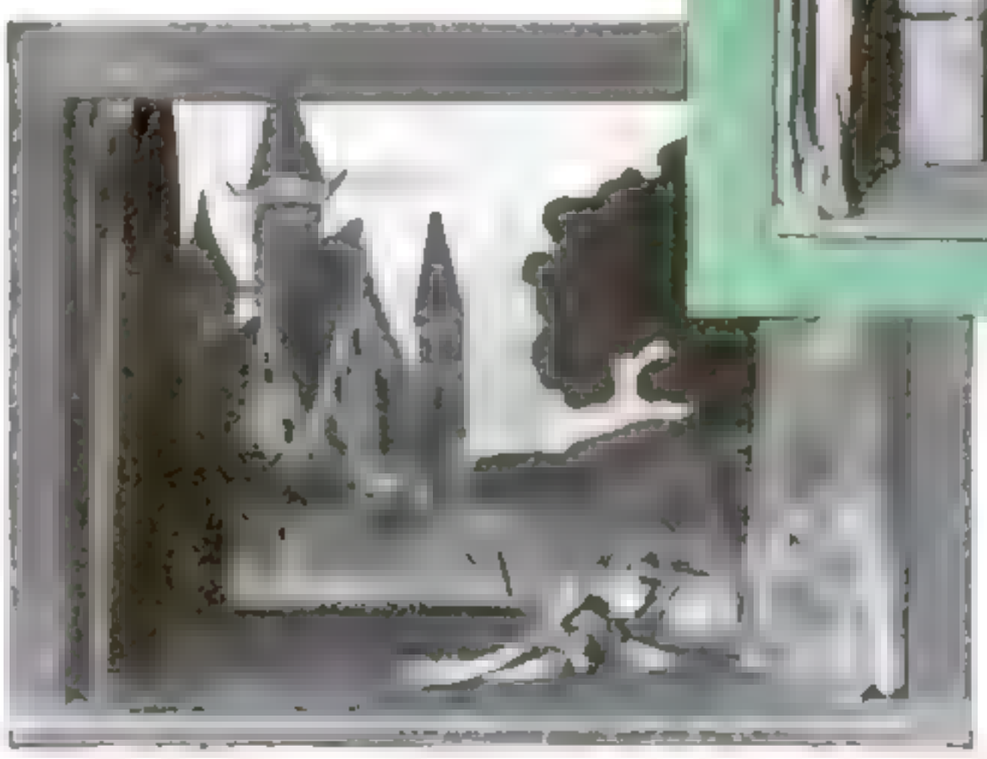
Florence Fetherston Drake gives hints on making and painting back drops, trees, buildings, and interiors . . . How to get professional effects with simple materials

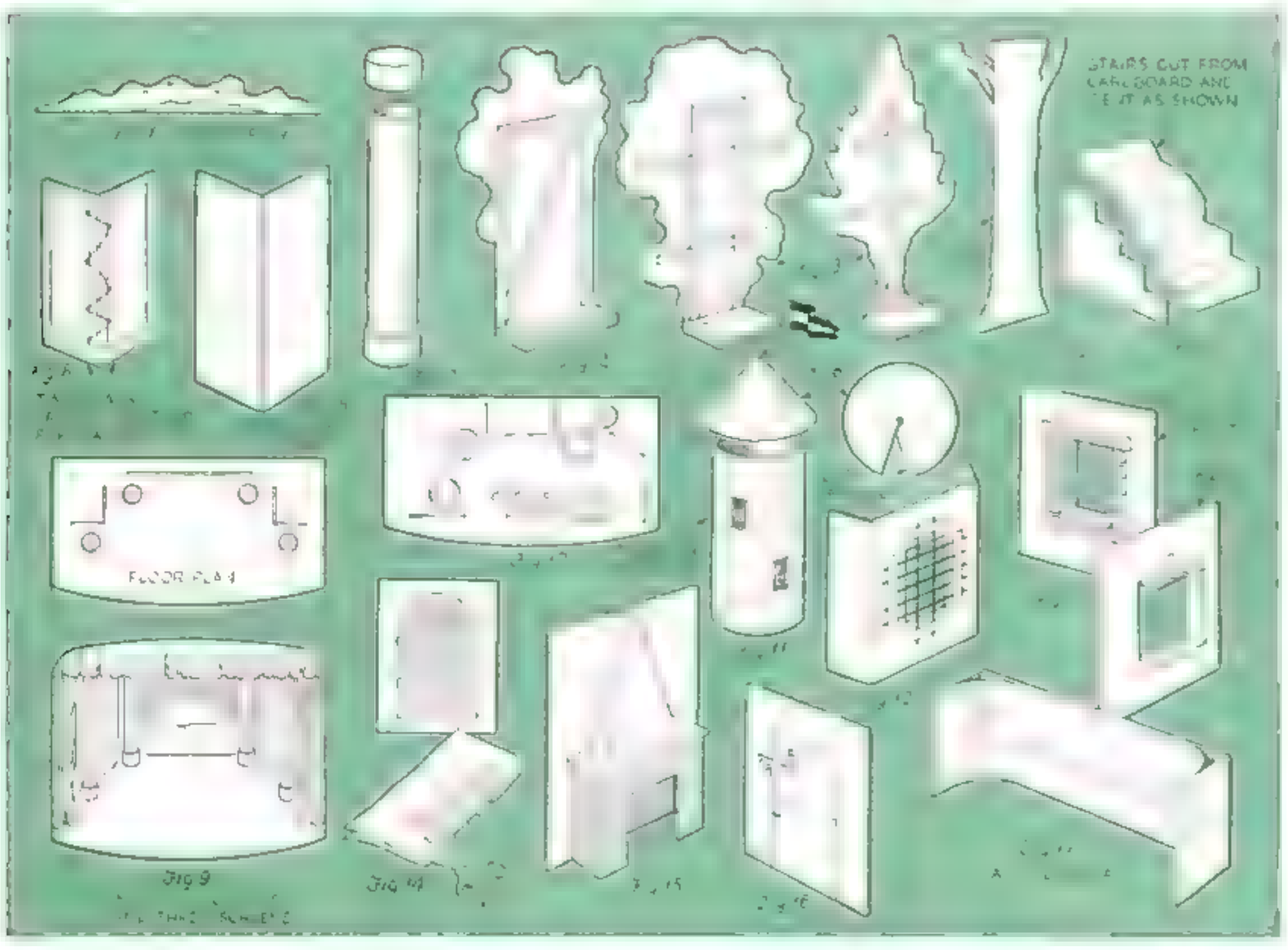
The castle scene shown at the right was made by Mrs. Drake from wooden and cardboard panels on which yardage goods are wrapped, pasteboard cylinders, tin cans, cigar boxes, corrugated board, shade sticks, and advertising yardsticks. The fairy setting below is another example, and the sketches give the methods

ALL sets for marionette shows should be simple, with as few distracting details as possible. Only what is essential to the play should be put in. Let both the color and the design be bold and definite so that they may be clearly seen from a distance by the audience.

Every setting must give the actors enough room to move about in and have the necessary exits. It should be a well-composed picture and related, if possible, to the scene that follows. This can be achieved, for example, by means of an exit into a castle or house to carry the interest of the audience into the next scene. Doorways that open upon courtyards or give glimpses of distant landscapes, and windows that open upon gardens are charming details.

As practically all types of sets and scenery require painting, a few hints on colors and their use will be given before the actual construction of the scenery is taken up.





Aniline dyes are excellent because they are so strong that very little gives a rich color. They can be bought by the ounce and mixed as necessary with water. Avoid the more expensive varieties and those that are soluble only in alcohol.

Dry tempera colors, which are sold by the pound in great variety, are also good. A quarter pound of each spectrum color is all you will need. These colors generally have enough adhesive in them to work well; should any be found to rub off when dry, add a little paste.

Never use ordinary oil paints for stage work because their shiny surface is objectionable. If, however, they are thinned with turpentine or gasoline until they become stains, they give a dull surface and can be used.

Mixing colors beforehand is likely to give a muddy result. The first coat should be pure, flat color, and the second coat should be put on in stripes or spatters so that the other color shows through. Under proper lighting, this gives what artists call "vibration" and makes the color "live." For instance, a bright orange coat with short strokes of brown over it gives a brilliant golden brown. In the spatter method, a brush full of color is held in one hand

(Continued on page 106)

PERFORMING MAGIC STUNTS WITH PAPER LOOPS

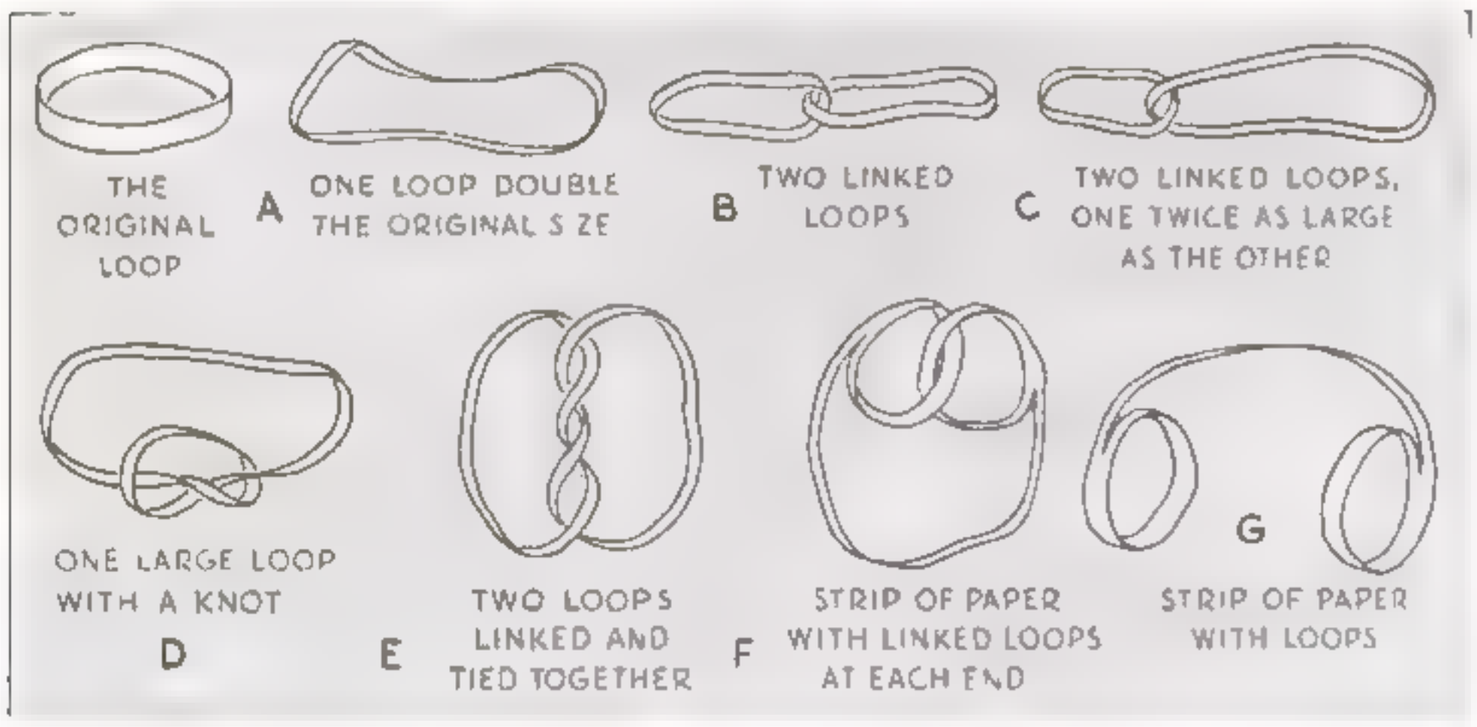
HERE are some mystifying tricks that you can do with a few strips of paper, some paste, and a pair of scissors. Cut several strips of paper about 1 in. wide and 18 in. long. Hand them to some of your friends with the request that they paste the ends together so that a single lengthwise cut will give two loops interlinked like a chain, as shown at *B* in the accompanying diagram. After this has been accomplished or demonstrated, ask them to paste a strip that will, when cut, make a loop of double the original size *(A)*, or one that will give two loops interlinked and tied together *(E)*, or a single loop with a knot in it *(D)*. After doing one or two of these, they may "catch on" to the general method, but you can then stump them by asking them to cut the original loop so they get two loops linked together as before, but one twice the size of the other *(C)*. An equally puzzling problem is to cut the loop into a straight piece with loops at each end and these loops interlinked *(F)*. To make clearer what you want them to do, it is an excellent plan to draw some rough sketches similar to those that appear in the accompanying drawing.

The tricks are done with strips of paper about 1 in. wide and 18 in. long, pasted to form loops and then cut lengthwise through the center with scissors as shown

The different forms of loops produced are determined by the amount of twist given the original loop before pasting together and by the manner of cutting. To form *A*, give the loop a half twist before pasting and cut straight down the center, *B* requires one full twist, *D* a twist and a half, and *E*, two twists.

The other three forms *(C, F,* and *G)* require a spiral cut. Start about a quarter of the way from the edge and cut at a slight angle so that the scissors are cutting in the center of the strip at the end of the first cut right around the loop. Then continue around once more, gradually working over half the remaining distance, so that the cut ends at a point one quarter the width on the other side of the center. (When practicing this, it may help to draw a pencil guide line.) If this method of cutting is used, and there is no twist to the original loop, the result will be *G*. A half twist gives *C*, and one whole twist, *F*.

If you can conceal the twist in the loop while pasting and cutting it, you will have a magic stunt. First demonstrate that a simple untwisted loop, when cut down the center, makes two loops. Then make another loop, but conceal the twist behind your hand, and after cutting you will have a single large loop or two linked loops depending on the twist.—PAUL R. RANNIE.



The way the loop is twisted before being pasted and the method of cutting determine the result

FLASH LIGHT ON WRIST LEAVES HANDS FREE

STRAPPED to the wrist, a small flash light like the one illustrated above makes it possible to use both hands when working in dark corners. A wrist-watch strap is satisfactory, and it is fastened to the flashlight case with a rivet.—E. A. BOWER.

LUBRICATING JIG-SAW GUIDES

THOSE amateur craftsmen who are partial to jig-sawing will find that it pays to use a graphite penetrating oil to lubricate the scroll-saw blade guide. The graphite fills the pores of the metal and forms a permanent lubricating surface.—K. M.

200 SHOP PATTERNS PRICKED AT ONCE

FACED with the problem of producing full-sized paper patterns in quantity for workshop projects, a California craftsman found that a darning needle with the point ground off flat, when inserted in a drill-press chuck and forced down like a punch, could easily prick through over 200 thicknesses of newsprint at one stroke. He tacked the sheets together, clamped a supporting board on the press table, and was able to follow the outline rapidly, making holes about ⅛ in. apart. The depth stop was set to allow the needle point to prick into the wood about 1/16 in.

Not only did he outline the patterns, but he also indicated the positions of overlapping parts by the use of double pricks—two spaced about 1/16 in., with 3/16 in. to the next pair. After pricking, he cut the stacked patterns apart with a band saw.—E. L.

A needle in the drill-press chuck pricks through the stack of 200 sheets, which are backed up by a board

MODERN NAME PLATES

...Jig-Sawed from Sheet Plastics

By ALBERT Q. MAISEL

After being cut out on a jig saw, the separate letters are fastened to the back plate with a special cement that is as strong as cast resin

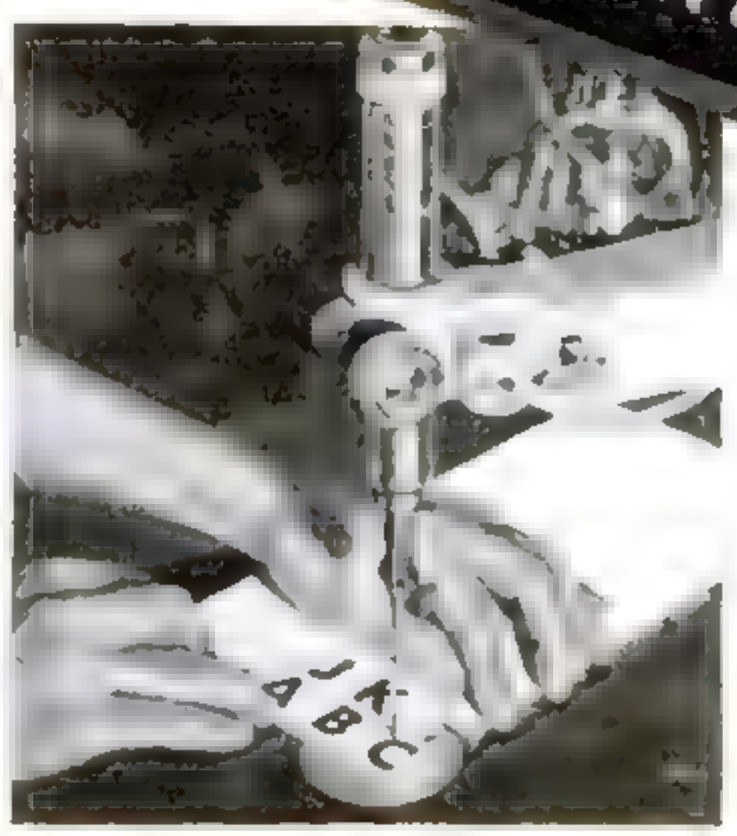
DECORATIVE signs and house numerals in great variety may be jig-sawed from cast-resin plastics, the beautiful new synthetic material that is rapidly coming into use for many home workshop projects.

The basic steps in fabricating a sign are essentially the same whether it is to identify a professional man's office, mark a rural mail box, or serve as an illuminated house number, a business name plate, or an advertisement.

A sign of the type attached to the wall at the entrance to a dentist's office will be described, but a slight variation in detail will enable the same methods to be applied to any desired purpose. If illumination is needed, the craftsman many substitute a translucent back panel for the opaque one used in this instance. If different lettering is called for, he has but to adapt another style of printer's type to his jig-saw work. And if a different type of suspension is necessary, the sign may be attached to a light box, suspended from a bracket, or set up on an easel.

The letters for the sign illustrated were cut from ¼-in. thick white cast-resin stock, and they were mounted on a 1-in. thick panel of black stock, 6 by 15 in.

The first step is to lay out a roughly lettered sketch showing the over-all size and shape of the back panel and the general scheme of the lettering. It is best to allow an ample margin between the extremes of the lettering and the edges of the background panel, both for the improved appearance that will result and because letters too near the edge of the back panel may become damaged



Drilling and countersinking the holes for the screws with which the name plate is to be fastened to the office wall

The size and kind of lettering depend on the uses to which the sign is to be put. The best way to determine the size needed for any location is to set your sketch in the position the finished sign will occupy and study its appearance from all angles of vision. If a translucent back panel is to be used, in conjunction with indirect lighting from the back of the sign, slightly smaller letters than would ordinarily be required will be found desirable, because the lighting gives an optical illusion of greater size for each individual letter.

Lettering styles may be obtained from a number of sources. Most public libraries have books on sign painting with alphabets of various kinds, including block letters and script. Local printers will often lend an old sample book of type faces or, for a moderate price, will set the lettering in the desired type and furnish several proofs. Finally, as an unfailing source, refer to the large-type advertisements in newspapers, particularly of department stores. Except in cases where very large letters are used—over 3 in. in height—the craftsman will do best to restrict himself to the so-called "sans-serif" types, which have straight edges and a fairly even thickness of stroke throughout. Experienced workers (or those making larger letters or numerals) may, however, cut fine script in cast resins without fear, since the material may be sawed with extreme accuracy if proper care is observed.

Having selected the type face and size, mount the individual printed or drawn letters on the sheet you wish to cut, using ordinary library paste or any water-soluble glue. Make certain that the adhesive is applied evenly and that a firm bond is obtained all around, so that the lettering will not be torn loose from the plastic material in the process of jig-sawing.

The actual sawing may be done either with a motor-driven jig saw or with a hand scroll saw in which a fine jeweler's blade is used for all curved work, and either the same blade or a slightly thicker one for straight-line cuts. Before sawing the letters, drill holes within all inclosed parts of letters—such as the A's, B's, O's, R's, and P's—to enable the blade to be entered. Since it is usually easier to work with a comparatively large piece (particularly when using a motor-driven jig saw), it is well to cut out these inclosed portions of the letters before severing the individual letters from the block. All the outer edges of the letters can then be cut by letting the blade enter *(Continued on page 113)*

How to Make Distinctive Small Signs and House Numbers, Either Plain or Illuminated

SHAPING

Picture-Frame Moldings

FROM SCRAPS OF HARDWOOD

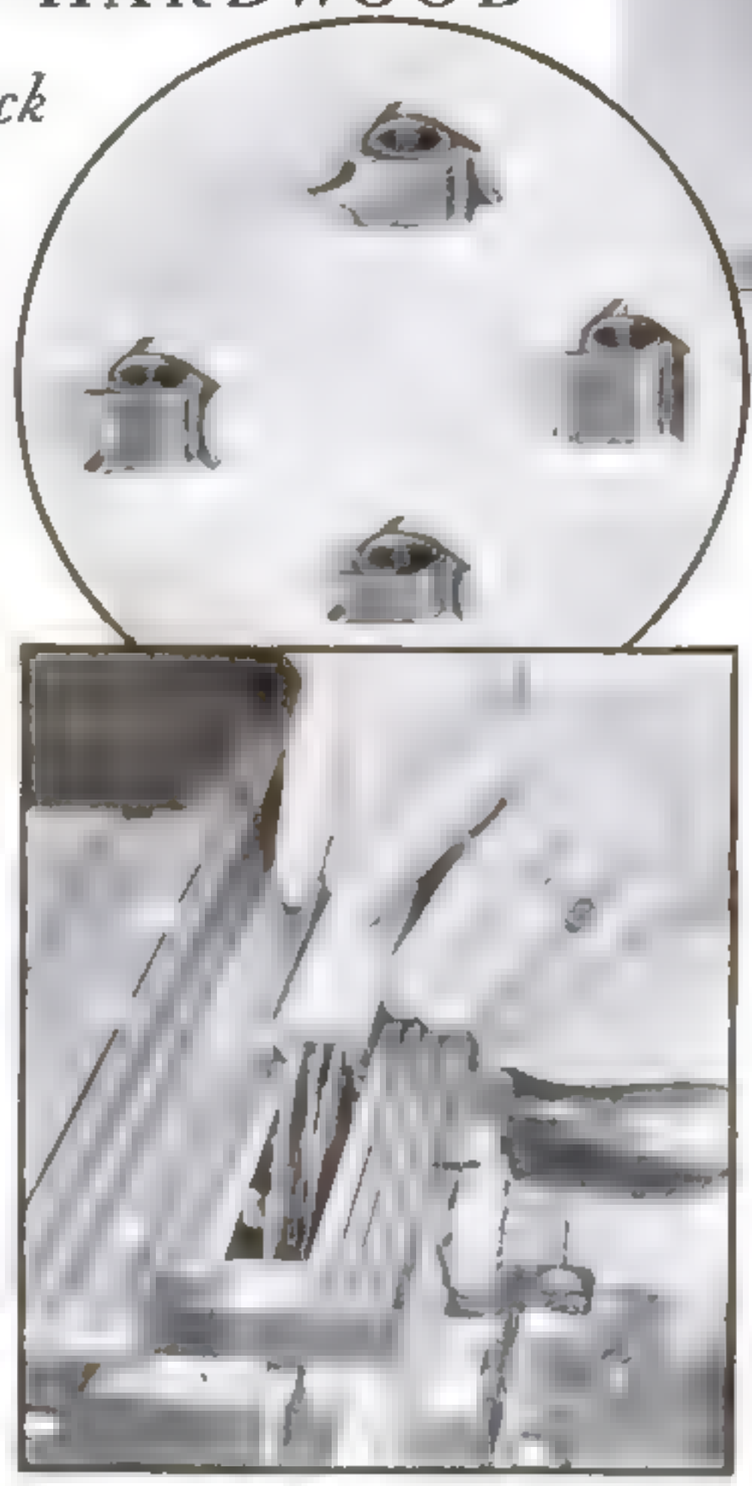
By C. Elmer Black

The double-width strips are molded on both edges with shaper cutters of the type shown at the left, which may be combined to give a variety of forms

ATTRACTIVE picture frames can easily be made in the home shop from scraps of valuable wood left over from furniture projects. The craftsman then has an opportunity to color or shape the molding to his own ideas of harmony and proportion, and the frames cost practically nothing.

The common practice of using a narrow strip of wood on the shaper is dangerous, and it is difficult to make an accurate cut because of the vibration of the wood. In the method to be described, a wider piece of wood is used. This keeps the hands away from the sharp cutters; the wood rests solidly on the table while being worked, thus insuring accuracy; and the only power tools necessary are a circular saw and small spindle shaper. Two strips of molding are made at one time, the only waste being that cut away by the saw and cutters. This saving is important when expensive or rare woods are used.

Before starting work, the size of the finished frame should be determined. The larger the frame, the wider the molding, both for strength and proportion. As an example, suppose a frame 8 by 10 in. is desired. For this size, molding about ½ by ½ in. will be suitable, therefore rip the strips ½ by 1⅛ by 24 in. (or they can be purchased from a lumberyard at small cost). It is important that the wood be uniform in width and thickness. The length, however, can be any convenient dimension that will cut to advantage.



The rabbet for holding the glass, picture, and backing is cut on the circular saw exactly as if it were a dado in the center of the molding

After the wood strips are prepared, the next step is to select a cutter, or combination of cutters, to give the shape wanted. By using the several cutters available, singly or combined, and by raising, lowering, or tilting the spindle, an unlimited variety of shapes can be made. When the cutters have been selected, lock them on the spindle and use a small straightedge (a 6-in. steel rule will do) to line up the front and back guides with that point on the cutters which will barely scrape the wood. In the case of a concave cutter, this will be the point on its arc that is nearest the spindle. This is to insure a uniform cut on the strip, and to avoid a taper.

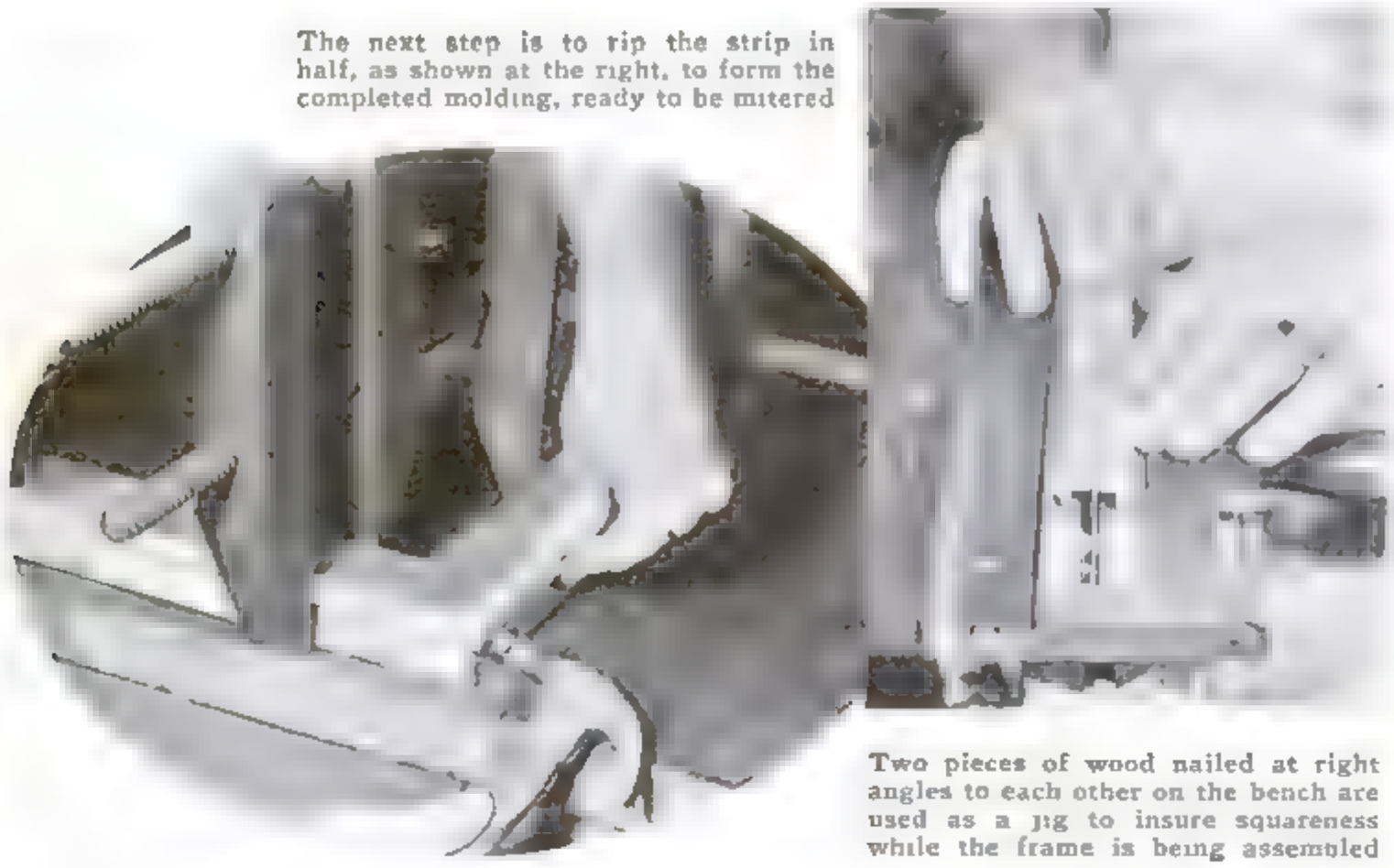
Have the spindle revolve about 10,000 r.p.m., and when more than one cutter is used, stagger the edges to give a smooth cut. Keep the strip pressed firmly against both the table and guides while feeding it past the cutter on one edge; and turn it around to do the same to the other. When starting the cut on the shaper, always begin about an inch from the end of the strip and pull the piece slowly toward you to reach the end, then push forward to complete the entire strip; otherwise the cutter may either knock the wood from your hands or split the strip.

The next step is to cut the rabbet in which the glass and picture fit. On the circular saw, use the dado to make this ¼-in. deep cut, and set the fence so that the dado is centered in the piece of wood. If enough chippers are not on hand to make a wide enough cut in one operation, use what you have and run the strip through to cut slightly more than half of the rabbet; then turn it around and run it through again, as was done on the shaper. The latter method is better as the cut must then be the same distance from each edge.

After the rabbet is cut, it remains to rip the piece exactly in half on the circular saw, and the result is two identical strips of molding. Use fine sandpaper to smooth the strips, but be careful not to round off any sharp corners.

Miter four *(Continued on page 109)*

The next step is to rip the strip in half, as shown at the right, to form the completed molding, ready to be mitered



Two pieces of wood nailed at right angles to each other on the bench are used as a jig to insure squareness while the frame is being assembled

Finishing Our Model of the *GREAT REPUBLIC*

Capt. E. Armitage McCann tells how to cross the yards, complete the rigging, ship the rudder, and add the flags

ANY type of cradle or stand may be used to hold our new model of the *Great Republic*, which is now nearing completion. If, however, you intend to use a so-called "graving dock" base, as shown in the photographs, this should be made before the yards are crossed. I did not fasten my model down before because it was handy to be able to lay her over when working on the deadeyes. Now, however, I set her on eight sets of ⅜-in. thick keel blocks, and screwed up through the second, fourth, and seventh into the hull. I screwed the corresponding lower blocks to these, and screwed those in turn to the baseboard. The other chocks are merely glued in position. I bored through the base at an angle to take ⅜-in. dowels, which I pushed up against the hull until the model was upright, and then nailed them to the base to form shores and hold her there.

All the yards hang in lifts when lowered. For the upper ones, I hitch a cord to a yardarm eye, catch a turn around it (with needle and thread) to the eyes of the rigging; hold the yard horizontal, and draw tight and knot the thread.

The braces get in the way of each other when being rove off, so I find it easiest to start at the top of the mizzenmast.

The spanker mast is short so the upper mizzen braces have to lead forward as with a full-rigged ship. The skysail braces both lead through one double block seized abaft the main topgallant rigging and then down, as straight as possible, to the main fife rail. The royal and topgallant braces lead through double blocks, which are seized one each side of the topmast rigging, and down to the same place.

The main skysail braces lead through single blocks on each side, abaft the eyes of the mizzen royal rigging and down to the pinrail on either side. The royal braces are the same, but with blocks at the topgallant masthead. The main topgallant yard brace is double, starting each side with a knot on the mizzen topmast stay, through a block at the yardarm, and back through a block under the crosstrees, abaft the rigging.

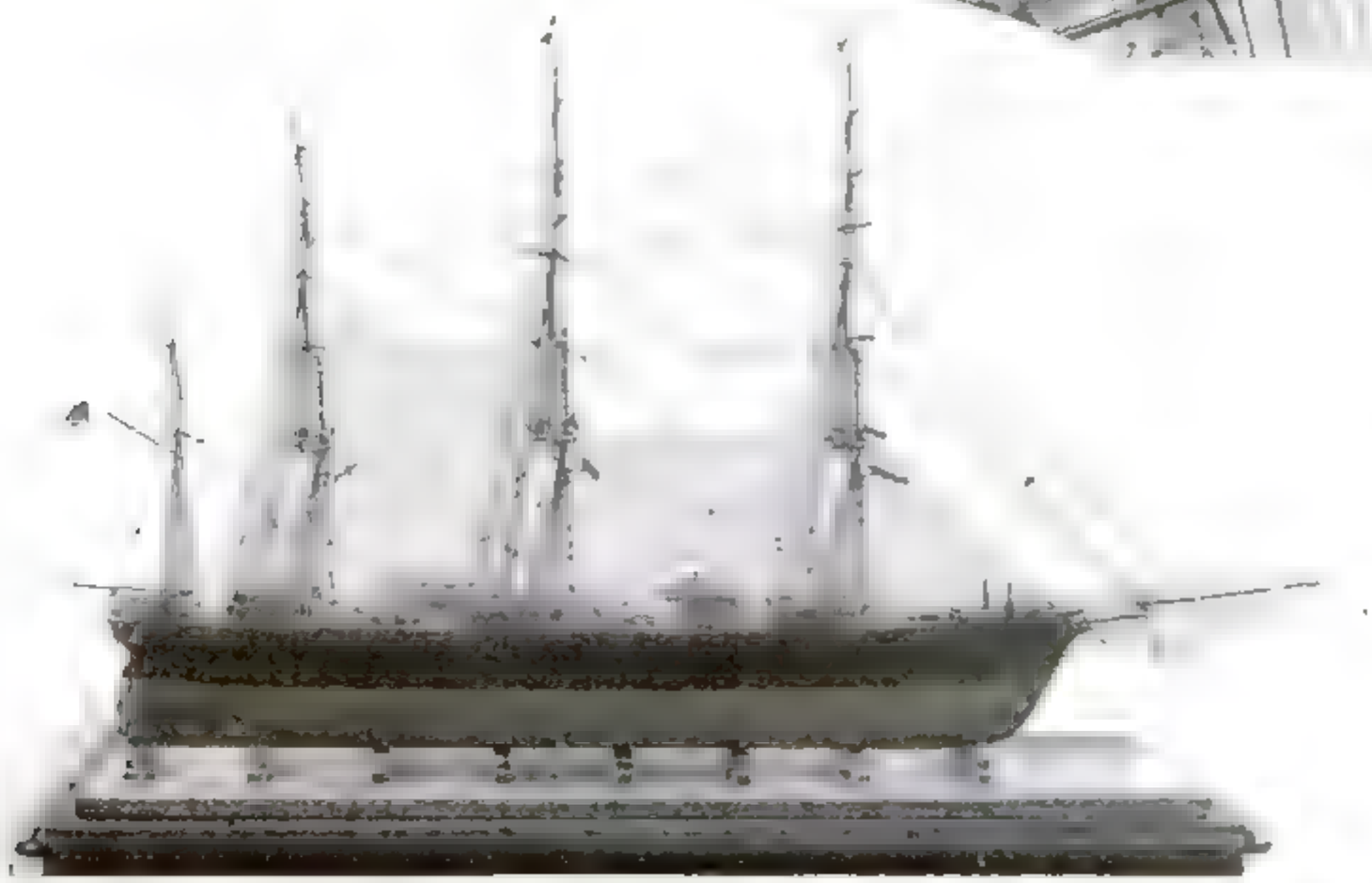
The finished model of the *Great Republic* on a base of the so-called "graving dock" type, with a shore amidships at each side

The fore skysail braces lead through blocks seized to the main topgallant stay, through blocks seized to the rigging abaft and down. The royal braces each side go through a double block seized to the main topmast stay and a double block abaft the mast. The topgallant braces start with a knot on the main topmast stay, though blocks at the yardarms and back through the other holes in the royal brace blocks at the masthead.

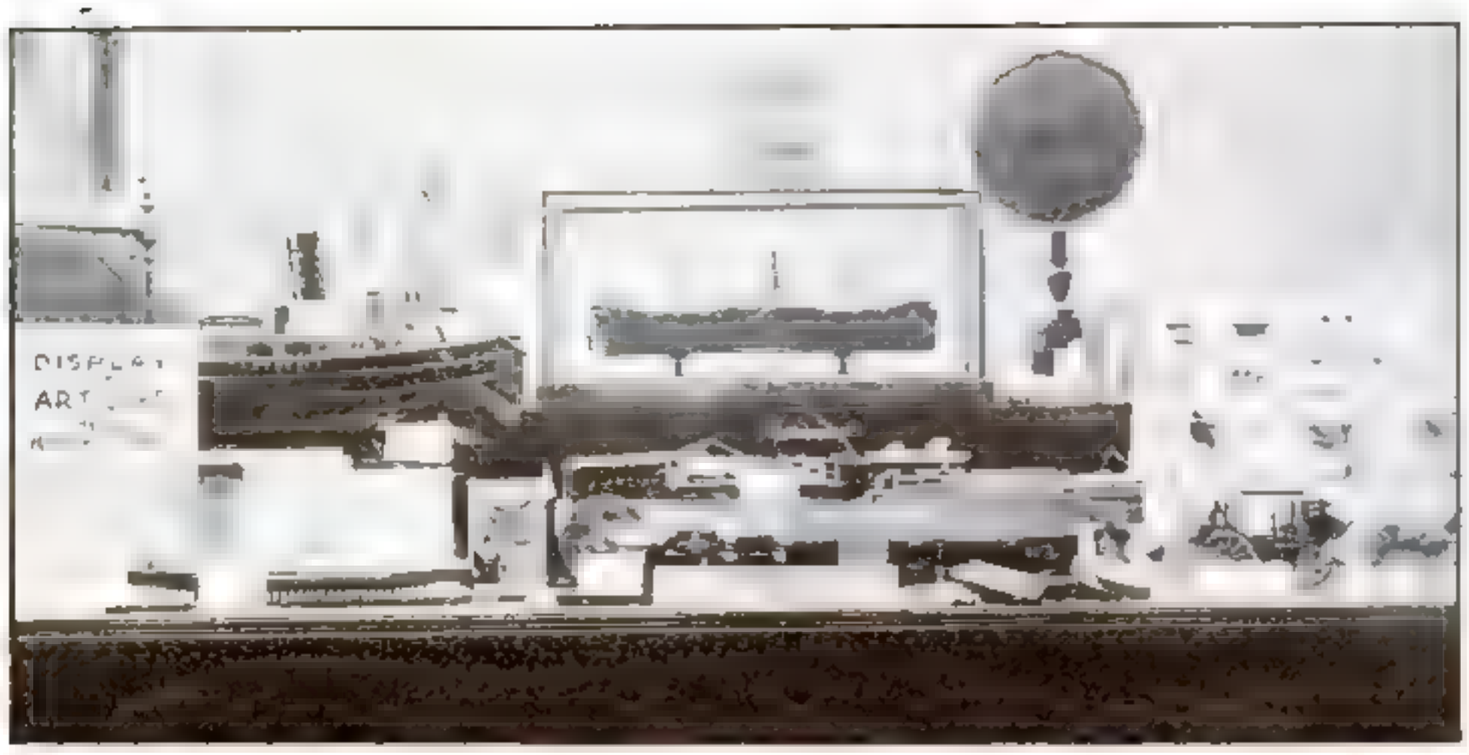
To make all the yards lie truly across the ship, I take a half turn with their braces over their belaying pins, with enough end to reach across the deck. I lay a stick across the deck; then, looking down the mast, I tighten or slacken either brace until they are true. The braces should be tight, but not so tight as to slacken the stays.

These yards will need halyards, which are single cords, hitched to the eyebolts on the yards, rove through the masthead holes and down to their respective positions, where blocks are seized in as shown on the previously published rigging plans (P.S.M., Feb. '36, p. 73). Use two single blocks for the skysail, double and single for the royal, and two double for the topgallant.

The halyards of the upper topsail yard have a chain tie, starting at the yard and reeving through the mast, with a block seized on abaft. A line starts at a bolt in the top, reeves through this block and down to a *(Continued on page 94)*

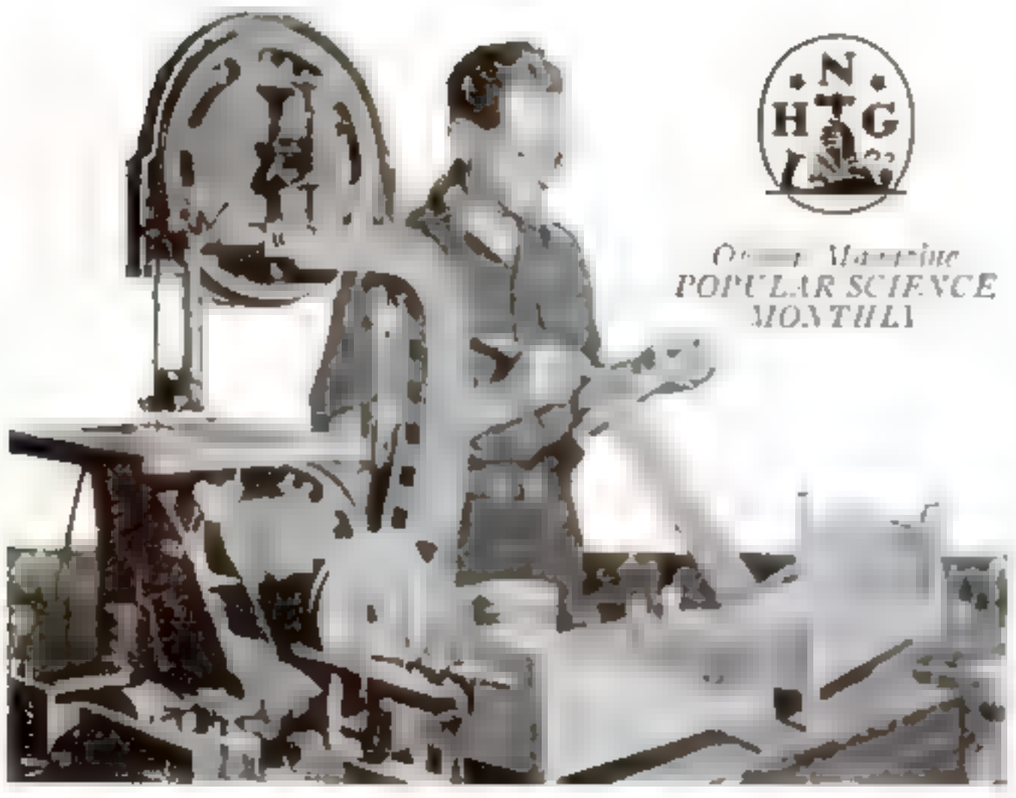


If you have followed the plans carefully, this is how your completed model should look when viewed squarely from the side. The photograph in center of page shows all the foremast yards



Part of a window exhibit by members of the Richmond (Va.) Homecraft and Modelmakers' Guild

BUILDING MEMBERSHIP IN A Home Workshop Club



M. T. Turner, member of the board of governors of the Richmond club. He is putting finishing touches on toys made for the needy

"WHAT is the best way to increase the membership of a home workshop club?" That is a question often asked by officers of the smaller clubs, especially by those who have had no previous experience in administering club affairs. They realize that their clubs have a nucleus of old and faithful members who turn out regularly for the meetings and who are interested in every phase of the craftwork problems that come up, but these men rarely bring in a new member or aid actively in building up the organization.

The first thing is to overcome this attitude on the part of the members. The many advantages of having a larger membership should be pointed out to them. They will be able to get a better meeting place, perhaps with shop facilities; they will be able to obtain demonstrators and lecturers with much less difficulty; they will find it easier to work out club projects and participate in community activities; they will have more funds in the club treasury; their social meetings will be far more entertaining, their exhibitions more varied and interesting, and their whole program speeded up to a much livelier and more satisfactory pace.

At the same time it must be recognized that the club has something genuinely worth while to offer to new members. In the past it has been the custom for home workshop enthusiasts to struggle along by themselves in their own little basement or attic shops. They have been individualists. Only now that clubs have been formed in many cities and towns through the efforts of POPULAR SCIENCE MONTHLY is it possible for them to enjoy real companionship in their hobby—to get help with their problems and see what the other fellows are doing. It doesn't require any great salesmanship to make a home worker see the advantages of this.

Once a club has been aroused to the membership problem, the details of a campaign can be worked out with every assurance of success. A membership committee should be appointed to plan and supervise the campaign, but each member of the club should be made to feel that he is to share actively in the work. The whole club must get behind the drive.

Some of the furniture, models, and other work of members of the Ashtabula (Ohio) Homeworkshop Club on display in a store window

Check up at the very start on the publicity the club is receiving from the local newspaper or newspapers. Are the meetings reported properly? Are announcements of coming meetings printed with an invitation for all those interested in craftwork to attend? If not, the secretary or some member appointed for the purpose should see that the papers are provided promptly with announcements and reports. Good publicity, kept up month after month, is certain to bring in inquiries from men who would like to join.

This newspaper publicity should be supplemented by placing posters in hardware and paint stores and local lumberyards. Some member of the club may be able to letter attractive posters by hand; if not, a local printer will set them up reasonably, or, better still, attractive jig-sawed or inlaid bulletin boards can be prepared with the club name and Guild emblem, and neatly typewritten announcements then fastened to them giving the time and place of the next meeting, an invitation to attend, and the name and address of the secretary. Some clubs have gone a step further and provided cards to be filled out by those interested and dropped into a box, from which they are collected at intervals.

Names can also be gathered in other ways. Each member should be made responsible for his immediate neighbors, some of whom may be glad to join. Hardware dealers should be asked for names of men who they know are doing craftwork at home. They will usually be glad to coöperate. An effort should be made to get the local manual training teachers to join, and they can help by telling their pupils to mention the club at home in case some of the fathers wish to join.

The name of each prospect should be listed, preferably on filing cards, and at intervals the

H. H. Hall, another member of the Richmond club, constructing toy horses for charity

names should be distributed among the members so that they can visit and interview all of the men.

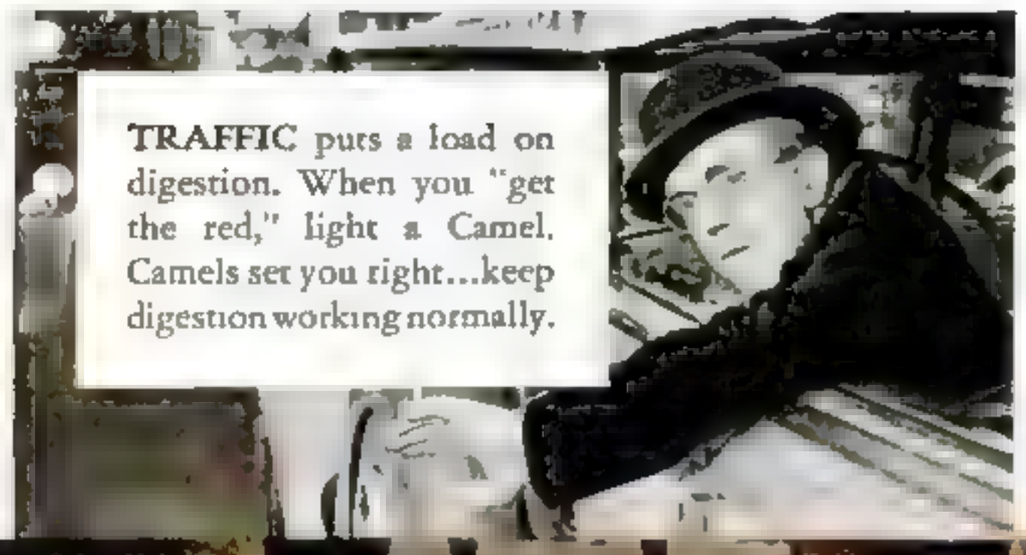
Advantage should be taken of the club's annual exhibition to gain recruits. Here again the use of posters and application blanks will help. Every inquiry should be followed up promptly, and the prospect invited to attend the next meeting.

Persistent use of these methods, together with any other plans the membership committee is able to work out, will insure steady and encouraging growth and widen the whole scope of the club's activities.

(Club news will be found on page 110)

Send a stamped envelope for information on starting a home workshop club.

The fast pace of *Modern Living* puts an extra strain on Digestion

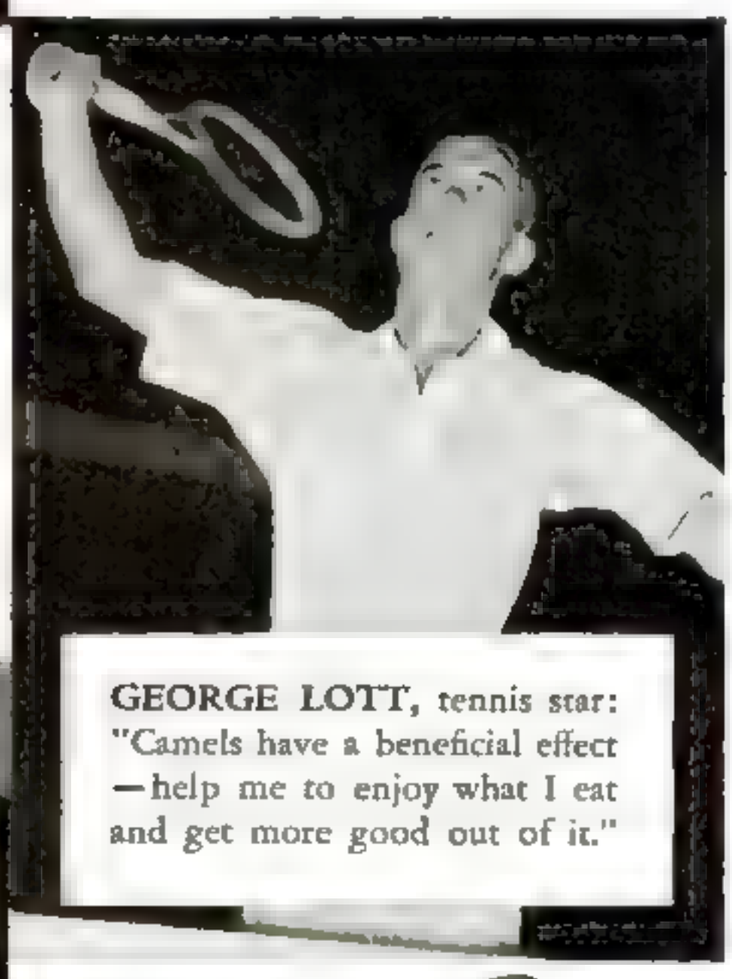


Natural digestive action notably increased by smoking Camels

People in every walk of life get "keyed up." The effects on digestion are known to all! Smoking a Camel promotes digestion. Enjoy Camel's mildness...the feeling of *well-being* fostered by Camel's matchless blend of costlier tobaccos. Smoke Camels for digestion's sake!

"I ALWAYS take a big supply of Camels along," says William LaVarre, explorer. "They make any meal taste better—and digest easier." Mrs. LaVarre adds: "Camels help my digestion."

GUESTS AT KUGLER'S, grand old Philadelphia restaurant, are shown above, as they enjoy choice foods. William, of Kugler's, who presides over the famous dining room, is speaking to one of the diners. William says of Camels: "Camels and good food go together. Our patrons naturally prefer quality tobaccos, judging by the popularity that Camels enjoy here. So we try to keep well stocked with Camels."



GEORGE LOTT, tennis star: "Camels have a beneficial effect—help me to enjoy what I eat and get more good out of it."

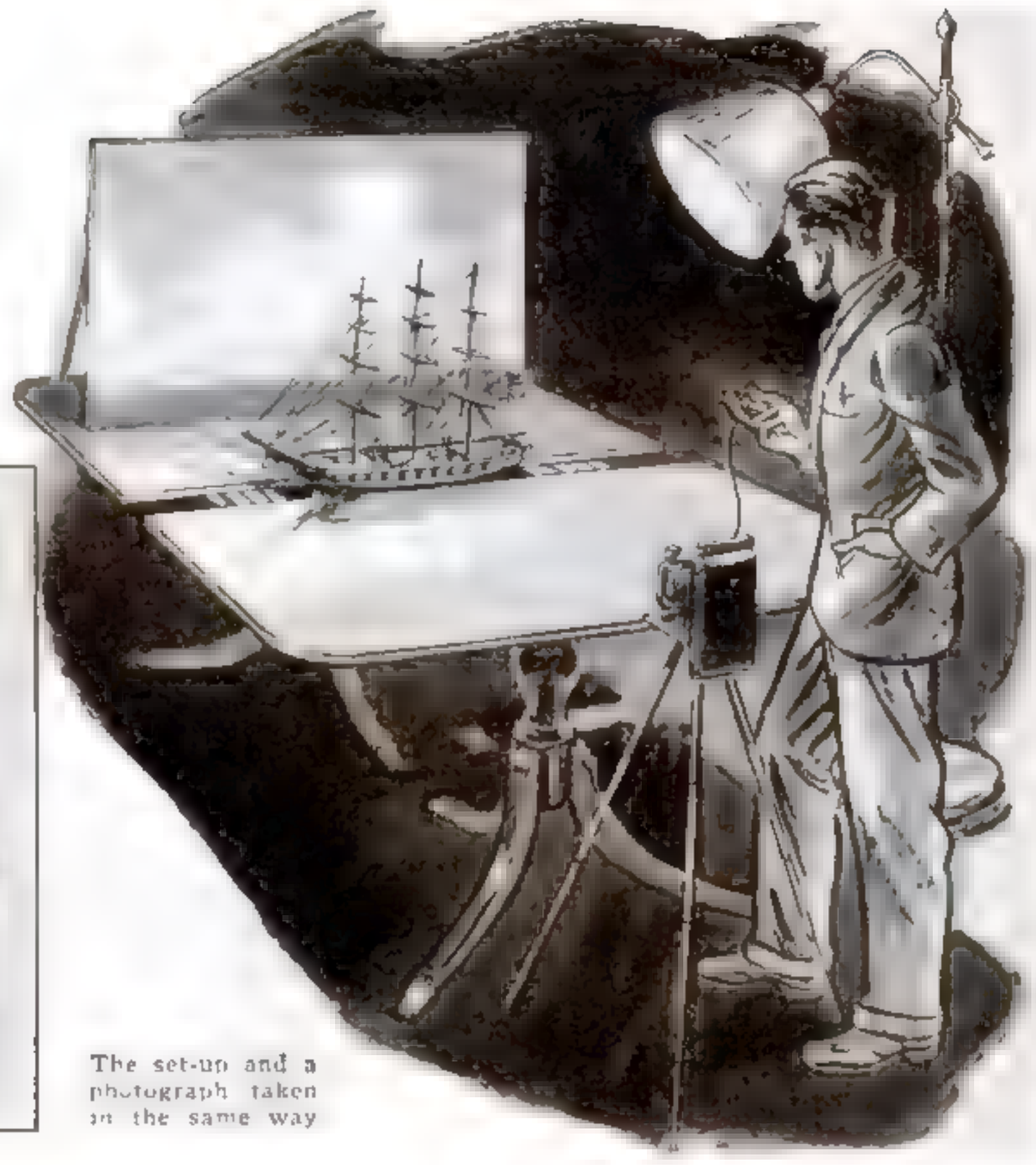
TUNE IN! Camel Caravan with Walter O'Keefe, Deane Janis, Ted Husing, Glen Gray and the Casa Loma Orchestra.

•

Tuesday and Thursday—9 p. m. E. S. T., 8 p. m. C. S. T., 9:30 p. m. M. S. T., 8:30 p. m. P. S. T. —WABC-Columbia Network.

For Digestion's Sake—smoke Camels

HOW TO TAKE REALISTIC Photographs *of* SHIP MODELS



The set-up and a photograph taken in the same way

REALISTIC photographs of ship models, in a background of sky and water, can easily be made by any model maker who has a little sketching ability and knows how to use a camera. They offer an interesting change from the usual picture of the model on its stand. The requirements are a sky background drawn on a piece of cardboard at least twice the length of the model, and a reflecting surface to represent the water. Glass or tin foil may be used for the latter, but the polished top of a dining table answers the purpose well if the camera viewpoint is kept low as in the accompanying photograph of the Mississippi steamboat *Buckeye State*, a model constructed from POPULAR SCIENCE MONTHLY blueprints.

This picture was made by the method illustrated. The background may be done in light washes of water-color black with a large brush or in soft charcoal smeared on in cloud forms with the fingers or a rag. A loosely drawn, fuzzy effect is best to suggest distance. See that the sky generally has sufficient gray tone to provide a good contrast with the white paint or sails of the ship.

It is important to draw the horizon near the lower edge of the background and, strictly speaking, the camera lens should be on the same level when taking the picture. Otherwise the ship will not seem to be on an even keel. If no land is included, a flat band of gray slightly darker than the sky will represent the distant sea.

A single photoflood bulb in a bridge lamp or other shade, located well above the set and slightly to one side, will create the illusion of strong sunlight if care is taken that no shadows fall on the background or "sea" where they will be recorded by the camera.

The dining table has another advantage. The center joint, where the leaf extensions are inserted, may be opened just enough to take the width of the hull, the keel being supported below so that the table surface meets the water line. Focus on the near side of the ship. Absence of sharp focus on the background is an advantage. The gap in the table fore and aft of the model may be filled in with wood or cardboard toned to match the table, but at a low camera angle the gap is so narrow that it is scarcely visible in the picture. Variety in pictorial effect can be obtained by introducing small water-line craft, or a foreground of a dock or beach could be built up on the table.—JOHN W. OXBERRY.

STRAIGHTENING PRINTS

A SOFT sponge-rubber mat, such as a rubber kneeling pad purchased at a five-and-ten store, and a short length of ⅜- or ⅝-in. gas pipe make an excellent device for straightening photographic prints. Lay the prints face downward on the mat and roll the length of pipe over them, applying plenty of pressure. If it is desired that the prints have a little back curl, apply still more pressure. A ferrotyping roller, if available, may be used instead of the gas pipe.—E. H. C.

RIGID CAMERA SUPPORT BUILT OF WOOD

THE amateur photographer is sometimes confronted with the problem of providing a suitable upright rigid support for his camera when using it for enlarging or for photographing small objects from directly above. The accompanying photographs and drawings illustrate how such a support for any type of film-pack or plate camera, including those of the graflex or reflex type, may be constructed from a few pieces of ¾-in. thick wood. The size of the camera to be supported will govern the exact dimensions of the parts.

The first step is to saw two pieces as indicated in Fig. 1 of the drawings. Next place one on top of the other, set a small block of ⅜-in. material between them at the ends and in the center, and fasten with screws or nails at the points where the blocks rest. This completes the upright post.

Now cut two pieces, *A* and *B*, as shown in Fig. 2, and fas- *(Continued on page 83)*

TONIGHT make a picture
—that may win you $350.00

A SIMPLE picture that you can take at home—*tonight*—may win a cash award . . . as much as $350.

You don't need any expensive equipment . . . your present camera will do, if it can be set for "time." Night pictures are easy to take . . . fascinating, thanks to Mazda Photoflood or Photoflash lamps and Kodak "SS" or Kodak Verichrome Film. Make some of these pictures tonight—get your share of the awards. Eastman Kodak Co., Rochester, N. Y.

$2500.00 for Night Pictures

89 CASH AWARDS every month during January, February, March, 1936

2 awards of	$100 each
3 awards of	$50 each
4 awards of	$25 each
10 awards of	$10 each
20 awards of	$5 each
50 awards of	$2 each

$250 GRAND AWARD

A $250 Grand Award will be given to one of the six winners of the $100 awards; hence, the grand award winner receives $350 for a single picture.

RULES

1 Any number of pictures made on or after January 1, 1936, may be entered. Entries must be postmarked not later than midnight of February 15, March 15, and April 15—the three closing dates. Contests are open to any amateur in the United States and Canada (except employees of Eastman Kodak Company and those engaged in the manufacture or sale of photo supplies).

2 Prizes will be awarded *only* for pictures made at night, either indoors or outdoors, by artificial light. Winners will be chosen solely on subject interest and appeal, not on technical excellence. The decision of the judges shall be final.

3 Each prize-winning picture with negative and sole rights for advertising, publication, and exhibition in any manner shall become the property of the Eastman Kodak Company. If winning picture is of a person or persons, their (or, if under 21, the parent's) written consent to use the picture must be furnished before prize can be awarded.

4 Each print must bear, on the back, your name, address, make of camera, kind of film, and lights. No prints can be returned. Be sure to keep the negatives.

Mail prints only to
Prize Contest Office
Eastman Kodak Company
Rochester, N. Y.

Winning Combination for Pictures at Night

KODAK "SS" FILM . . . the ultra-fast film with the lightning stripe on the box. MAZDA PHOTOFLOOD LAMPS . . . give brilliant light, last for many pictures, cost 25¢. SIX-16 KODAK (*f*.6.3) . . . will make instantaneous 1/25 second snapshots indoors, at night, when used with Kodak "SS" Film and two or three Mazda Photoflood bulbs. For 2½ x 4¼-inch pictures—$20.

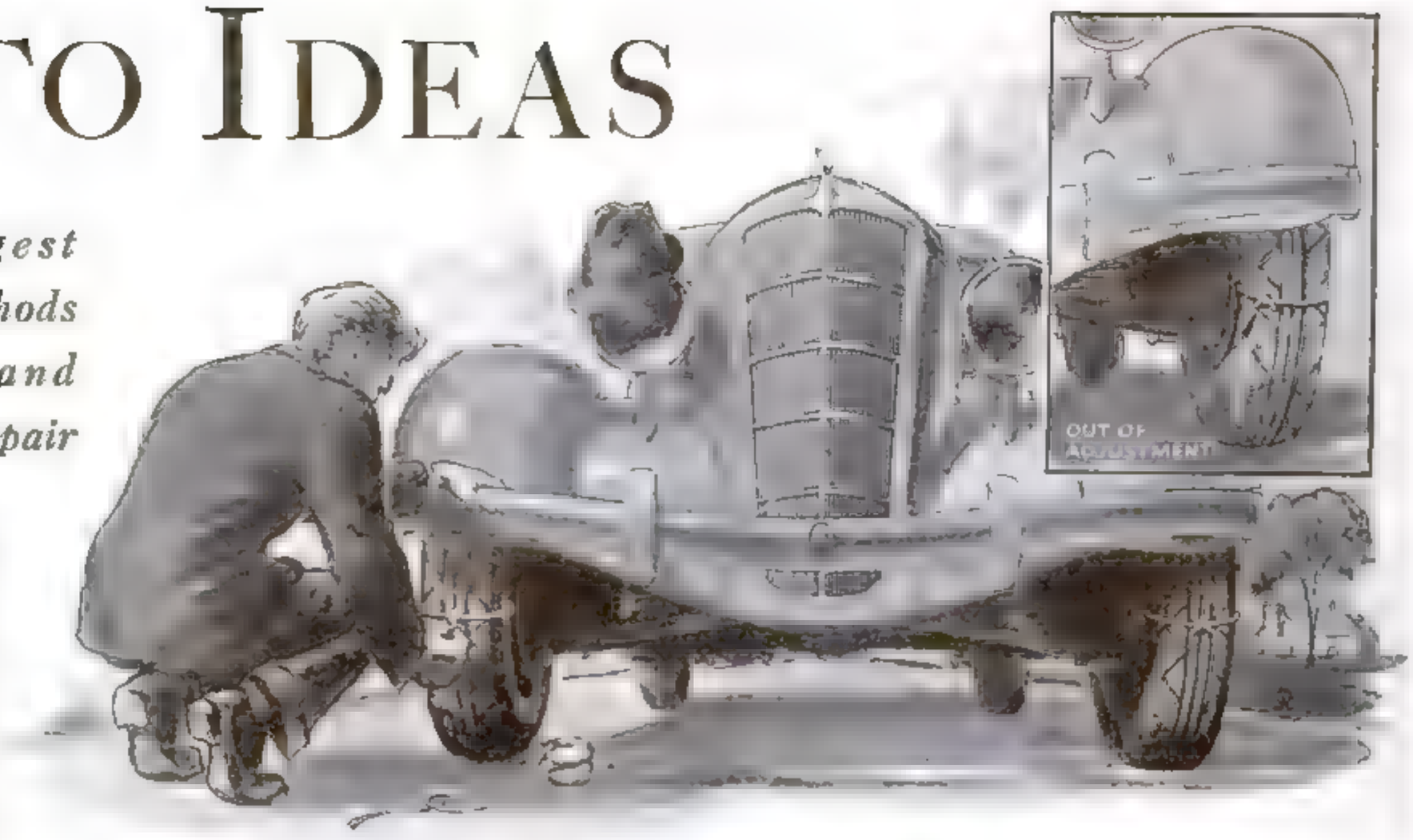
Accept nothing but the film in the familiar yellow box.

FREE — a booklet, all about Night Pictures

Write for your copy of this booklet, or get it from your dealer, today. It gives complete information about Night Pictures . . . what film to use . . . how to set your camera . . . where to place the lights . . . suggests subjects. Eastman Kodak Company, Rochester, N. Y.

AUTO IDEAS

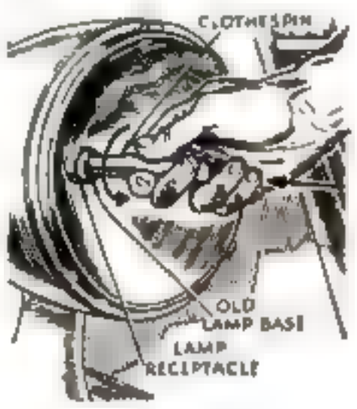
Our Readers Suggest These Simple Methods For Saving Time and Trouble in Car Repair



Cords around front tires, with large knots in center, check the adjustment of the wheels

HERE is a simple method I often use to check roughly the adjustment of a car's front wheels: After selecting a good stretch of smooth, level road, I tie a short length of twine around each front tire crosswise of the tread, making the knot large. Then I drive the car slowly for a few hundred feet and inspect the cords carefully. If there has been any definite movement of the knots across the treads, it is a good indication that the wheels need a thorough checking and adjusting. It is important, of course, to select a smooth, level road for the test. Otherwise road irregularities will tend to push the knots to one side or the other, regardless of the adjustment of the wheels. This test is not, of course, an accurate gauge of the type and the amount of adjustment needed but it can be used to obtain a fairly reliable preliminary check.—W. F. C.

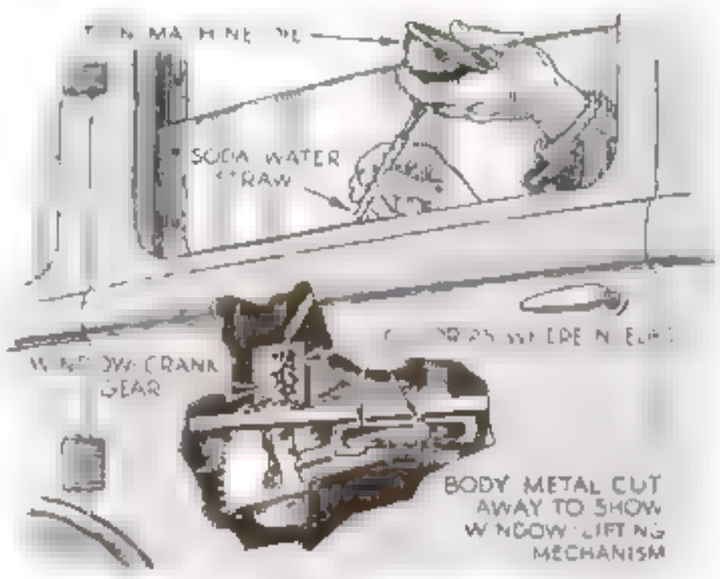
Clothespin Extracts Lamp Base



WHEN a headlight bulb breaks off close to its socket, it is sometimes difficult to remove the remains of the base. The job can be accomplished easily, however, with the aid of a clothespin. Simply squeeze the two prongs of the clothespin together, insert them into the broken base, and then turn with a pushing motion. The sides of the prongs will grip the base and release it.

Uses Soda Straw To Oil Stubborn Car Window

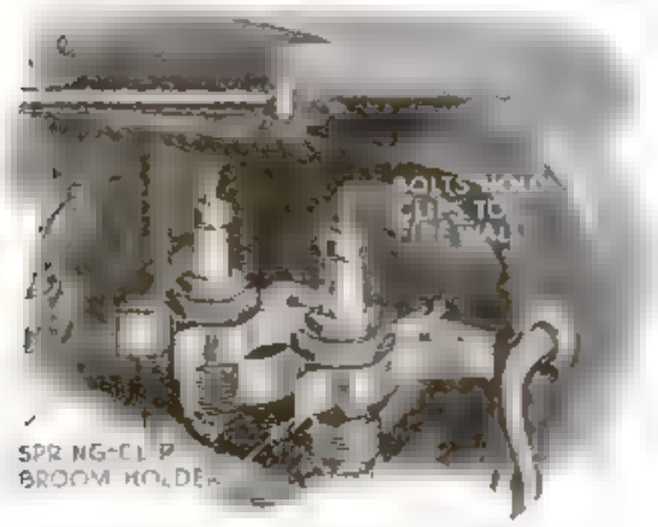
RECENTLY one of the windows of my sedan stuck and I could neither raise nor lower it. Deciding that a little oil on the right parts would loosen it, I was confronted with the problem of how to get the oil down inside the door to the gears and racks. I was just about to rip out the upholstery when the thought of using a soda straw occurred to me. Knowing in a general way what the operating mechanism looked like, I slid a straw down alongside the glass, inserted the oil-can spout into the upper end, and squirted away. By moving the straw around, I was able to reach all the moving parts of the mechanism and lubricate them thoroughly with the oil.—E. C. C.



Drawing shows how soda straw slid down inner side of door aids in oiling window gear

Spring Clips Hold Spare Spark Plugs

SPARE spark plugs stored in the tool compartment of a car are likely to be damaged by loose tools. A better idea is to mount a few spring clips of the tool-holder or broom-hanger type on the motor side of the fire wall. Your spare plugs will slip into them easily and be handy and safe when they are needed.—E. J. N.



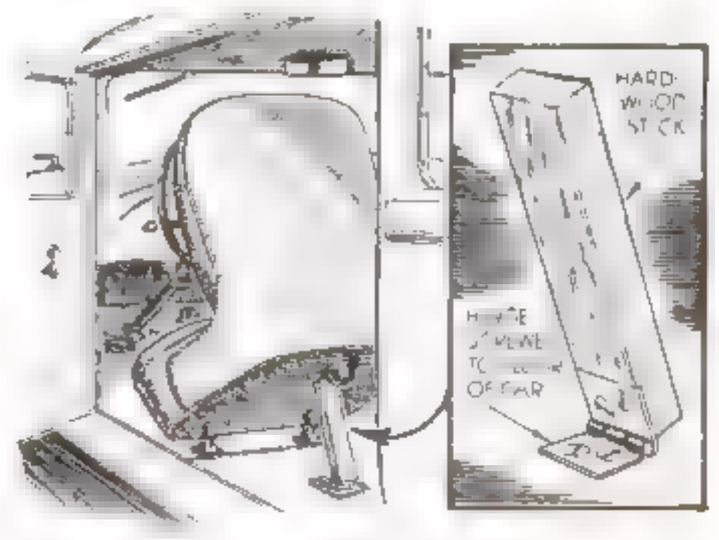
Spring clips mounted on fire wall under hood make handy holder for spare plugs

Jack Lifts Bent Fender

A FENDER crumpled in an accident often is bent in such a way that it binds the wheel and prevents the car from being moved. When it is impossible to force the fender out of the way by hand, try using an extension jack in the manner illustrated. The base of the jack can be placed on the ground or, if it is necessary to apply the pressure from a different angle, its base can be set against the wheel hub or axle.—J. C. C.

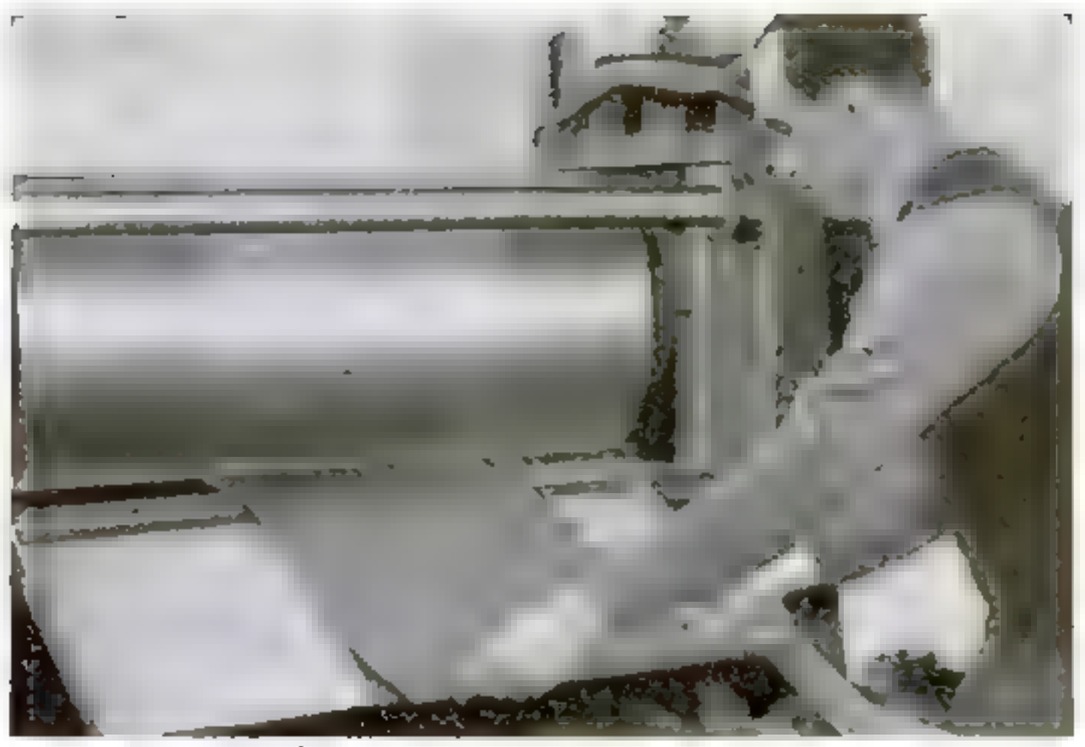
Prop Keeps Seat Raised

ALTHOUGH in two-door sedans having bucket-type seats, the driver's seat can be raised out of the way, it will not stay in that position unless held. To overcome this, I installed a hinged wooden prop under the seat. Now when I have a bundle to lift into the rear of the car from the left side, I merely prop the driver's seat up and have a clear passageway.—E. E. S.



This prop, shown in detail at right, keeps the driver's seat in tilted position when desired

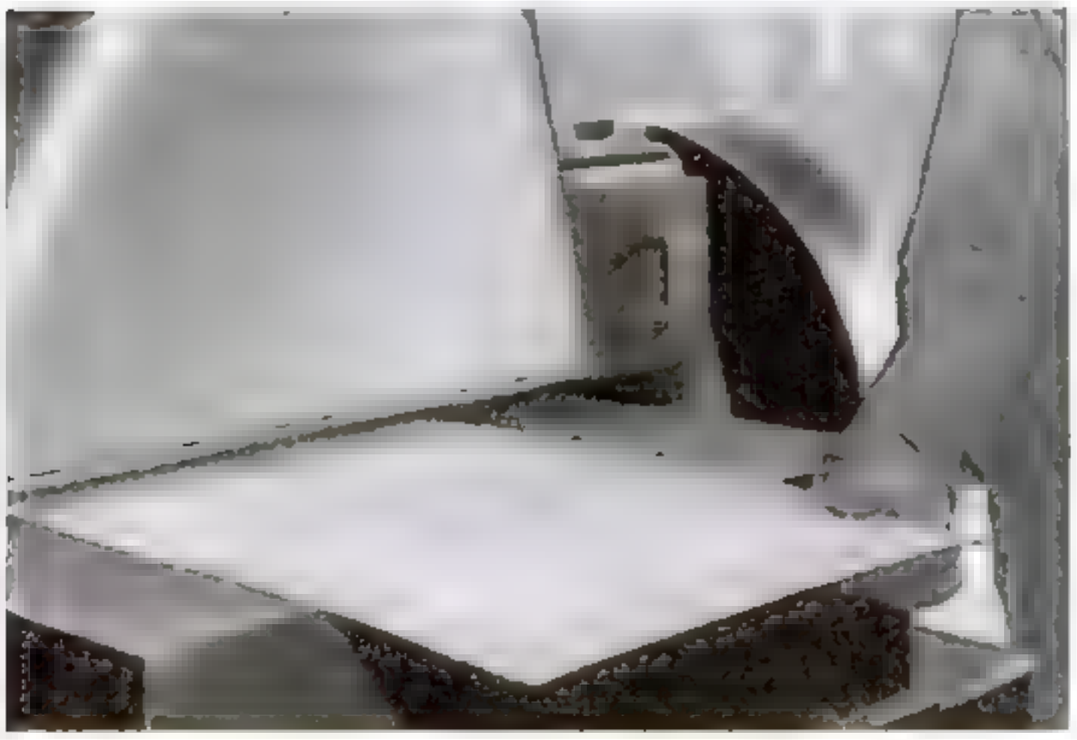
FORD GASKETS ARE BUILT TO WITHSTAND HIGH PRESSURE— UNDER FIRE



These rolls bend the tongues over to hold asbestos to steel core

THE development of the modern high-compression engine brought many new problems. Higher compression meant greater power and increased economy from smaller engines. But it also meant greater loads on various engine parts.

Many parts which served their purpose well in ordinary engines could not stand the added strain. New materials and new methods of manufacture were needed to meet the more severe requirements.



Forming the tongues in the steel core used in Ford V-8 gasket

Take gaskets for example. Each explosion in a Ford V-8 engine exerts pressure of about 600 pounds per square inch. That pressure must be held in by the cylinder-head gasket. And at the same time the gasket is exposed to the flame from burning gases with temperatures as high as 3000 degrees.

To meet these conditions required the development of an improved cylinder-head gasket. It has a steel core between two asbestos sheets which are mechanically and permanently bonded to it. The asbestos is so treated that water, oil or gasoline will not affect it. A steel edging around combustion chamber openings adds further strength and protection against blowing out. This type gasket is best for aluminum cylinder heads because it prevents the electrolytic action which causes gasket corrosion.

Regardless of where it serves or what it does, the most suitable and most economical part for a Ford is one which meets Ford requirements. When replacement parts are needed, insistence upon Genuine Ford Parts will help to maintain the high performance which was built into your Ford car or truck at the factory.

FORD MOTOR COMPANY • DEARBORN, MICHIGAN

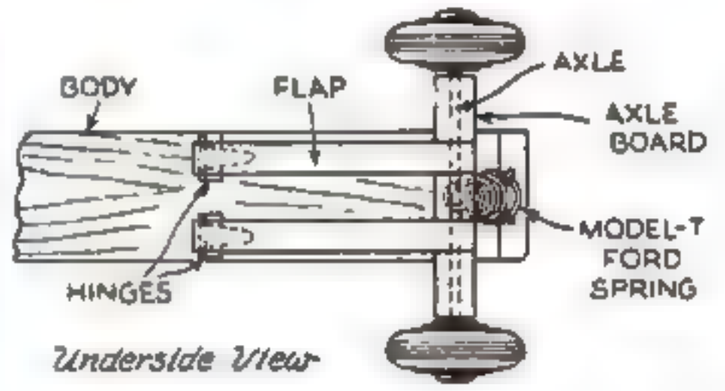
GENUINE Ford PARTS

One of the punch presses in gasket department at the Ford Rouge Plant.

Partially completed Model A gasket showing how flange is curled over asbestos liner.

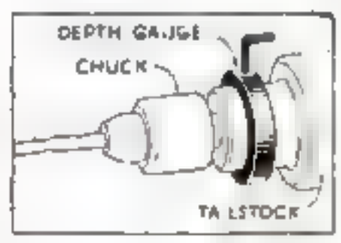
PROVIDING REAR SPRING FOR SOAP-BOX COASTER

TO MAKE my coaster ride more smoothly, I attached a model-T Ford spring to the rear end as shown in the accompanying illustrations. The axle is bolted to an axle board, which in turn is fastened to a pair of hardwood flaps. The flaps are hinged to the body with heavy T-hinges, bolted on. This arrangement gives me a smooth ride and eliminates side sway.—JOHN W. MCDONALD.



An underside view showing the hinged flaps, and a side view with the back rest omitted

SIMPLY MADE GAUGE FOR DRILLING IN LATHE



A DEPTH gauge for drilling in any lathe that has no such device can be quickly made on the lathe itself. Turn up a ring to slide, without wabble, on the tailstock spindle. It should be of a size to permit boring and tapping for a set screw to lock it in position. This screw should be made of soft brass rod of suitable size, as steel might mar the spindle. Bend the projecting end at right angles and cut it off, leaving about an inch for a handle. Some work can be saved by obtaining an old and reasonably soft cast-iron gear of approximately the correct size, from which to make the ring.

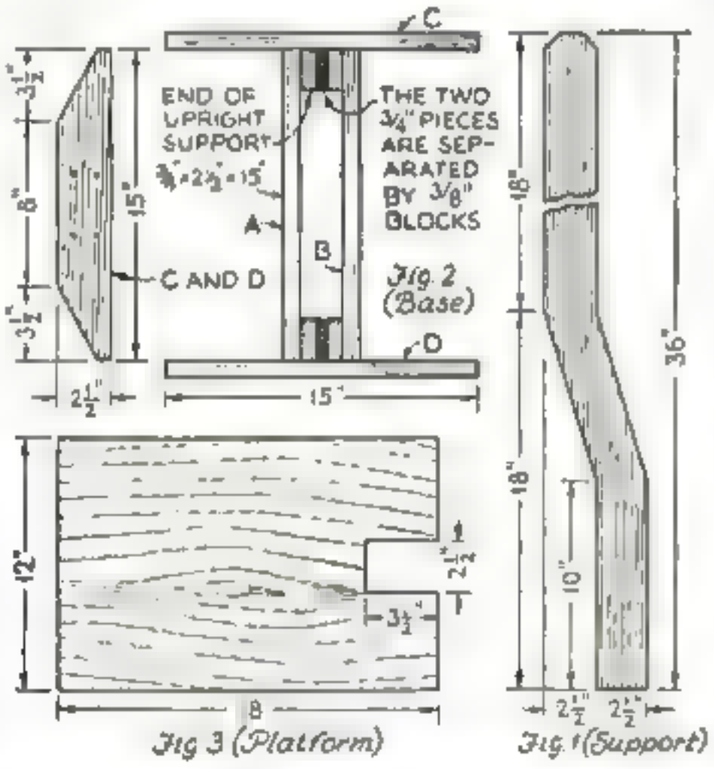
To use, run the point of the drill in until the outer corners of the flutes touch the face of the work; then slide the ring back along the tailstock spindle until it touches the tailstock, and clamp the ring. As the drill is fed into the work, the ring leaves the tailstock, and the distance may be measured with a scale without stopping the lathe.—M. A. COOPER.

RIGID CAMERA SUPPORT

(Continued from page 78)

ten them to the bottom of the upright piece. Two more pieces, *C* and *D*, are fastened to the ends of *A* and *B*. The platform for holding the bromide enlarging paper or for supporting objects is cut as indicated in Fig. 3.

In fastening the camera to the support, obtain a bolt threaded so that one end will screw into the tripod socket of the camera and so that the other end will take a wing nut. Pass the bolt through the opening in the upright piece, screw it into the tripod socket of the camera, place the camera at the desired height, and then tighten the wing nut. For taking special shadowless photographs, a sheet of glass may be inserted in a slot in the upright as shown.—ELMER H. CROOK.



The parts of the stand, which is set up and used as shown in the two preceding photos

SUCTION CUPS SUPPORT PHOTO BACKGROUNDS

Background hung on coat hook of the suction-cup type

AIDED by the new supersensitive panchromatic film, fast lenses, and photoflash and photoflood lighting equipment, amateur photographers now take more indoor pictures. In many cases, however, the existing backgrounds are objectionable because of their color, the conspicuous design of the wall paper, or other reasons. This difficulty may be overcome by making a few backgrounds of light material and holding them in the (Continued on page 85)

Our Whittling Kits

Are Reviving a Fine Old Hobby

NO. 7

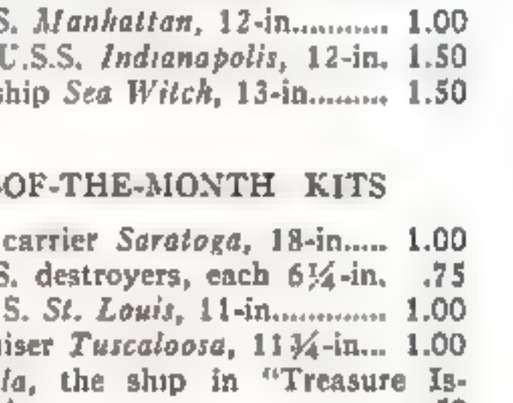
KIT O—An 11-in. model of the S. S. *St. Louis*

HAVE you noticed that our construction kits now include two projects for those who wish to take up the fine old hobby of whittling?

One of these kits, marked No. 7 in the following list, contains the materials and complete drawings and instructions for whittling a figure of Skipper Sam'l, the picturesque old sea captain shown in one of the illustrations above. Two blocks are included, both of them sawed approximately to shape so that no heavy cutting is required. One block is intended for practice purposes, but the step-by-step method of whittling the figure is so simple that there is very little chance of spoiling either block. You are almost certain to get two good skippers out of them, one to keep and the other to give away. The instructions, by the way, were prepared by E. J. Tangerman, an outstanding authority on the art of whittling.

The second kit, marked No. 8, is for making six small Scotties. The blocks are sawed to shape so that you can go right to work with your knife. The necessary paint, instructions, and a small sharpening stone are included.

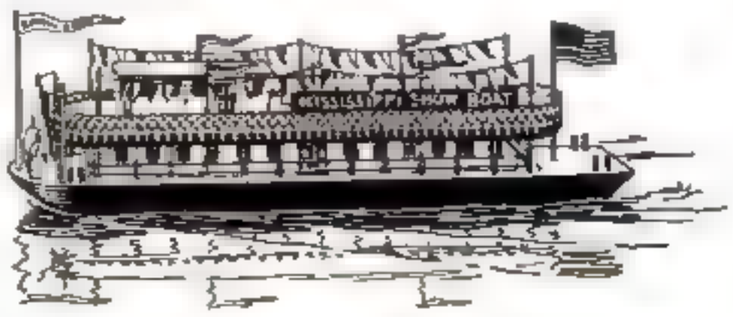
Our ship model kits, of course, are now in such common use that they are all well known. They are designed for those who want to build a model entirely from the raw materials, yet do not want to waste any time or money in shopping around for the numerous hard-to-get items required in making any ship model. The hull blocks or "lifts" for our standard ship models are sawed to shape, and the hulls for some of the smaller models are roughed out. Each kit is accompanied by the necessary blueprints or instructions.



Here is Rob, one of the six Scotties, all different, that can be made from our special whittling kit No. 8 in the list below. Six shaped blocks are in each kit

STANDARD SHIP MODEL KITS

A. Whaling ship *Wanderer*, 20½-in.... $7.40*
D. Spanish galleon, 24-in..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft. 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 7.25*
L. Farragut's flagship *Hartford*, steam-and-sail sloop-of-war, 33½-in. hull 8.45*
Q. Privateer *Swallow*, 12½-in. hull... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in hull ..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Destroyer *Preston*, 31½-in hull 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in hull 6.50*
4S. Clipper ship *Great Republic*, 31½ in hull 8.40*



KIT 1M—An illuminated show-boat model

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S. S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¼-in... 1.00
U. *Hispaniola*, the ship in "Treasure Island," 7-in. ..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50
3M. Yacht *Nourmahal*, 8⅛-in..... 1.00

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¾ in. high. Ready to assemble and stain included..... 5.75*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high. A knife, three bottles of paint, pocket sharpening stone, and instructions are included..... 1.50

No. 8. Whittling kit for six different Scotties. Each is 2 by 2¼ in., sawed to shape. Paint, paintbrush, instructions, etc..... 1.00

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†).

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If you prefer to send your remittance with this order, we will pay delivery charges. Remit by money order, check, or registered mail. This offer is made only in the United States and Canada

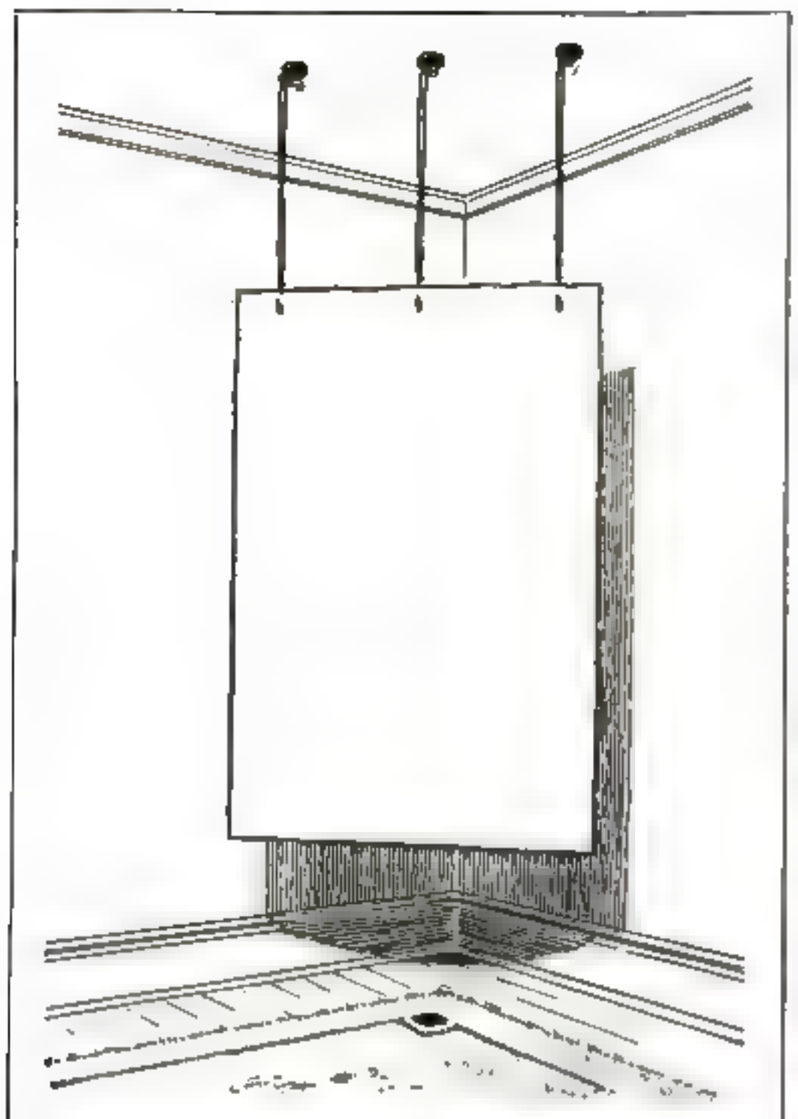
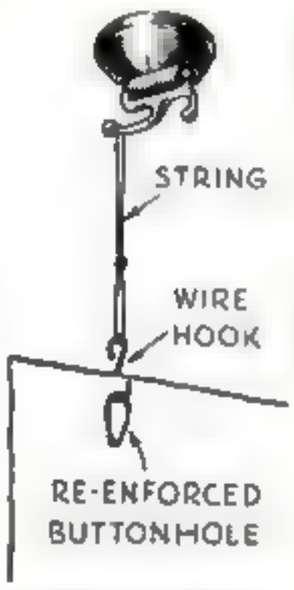


PHOTO BACKGROUNDS

(Continued from page 83)

desired position with suction-cup coat hangers. The hangers can be obtained at auto accessory stores, ten-cent stores, and department stores. Three backgrounds 6 by 6 or 5 by 7 ft. and preferably light, dark, and gray in color will be sufficient for the average amateur.

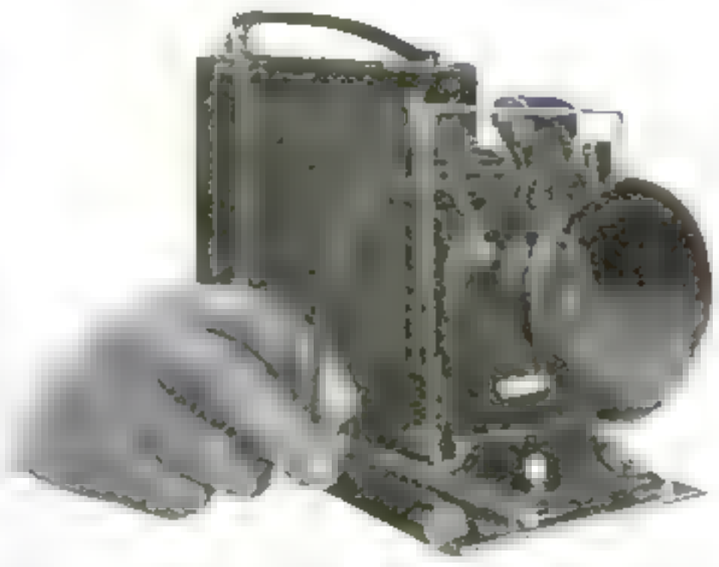
By removing some furniture or picture frames, the backgrounds may be used against the wall in most cases, otherwise the hangers can be placed against the ceiling and the backgrounds suspended with string. The advantage of the latter lies in having a background at right angles to the camera regardless of the direction of the light source or the position of the camera. This makes picture taking easier.—PETER C. RICHARDS.



How hooks may be used if necessary against ceiling

ALUMINUM FUNNEL USED AS CAMERA LENS HOOD

THE use of a camera sunshade has been recommended many times in previous issues, and various ways of making one have been suggested. Beginners in photography, however, seem to require actual experience to convince them that they can make better photographs at any time with *(Continued on page 86)*



By preventing overhead light from entering the lens, the hood insures snappier pictures

How to form a flange around the cut edge of the funnel to fit snugly over the lens cell

ALUMINUM LENS HOOD

(Continued from page 85)

the aid of a lens hood; and, of course, one is almost essential when the camera is facing the sun

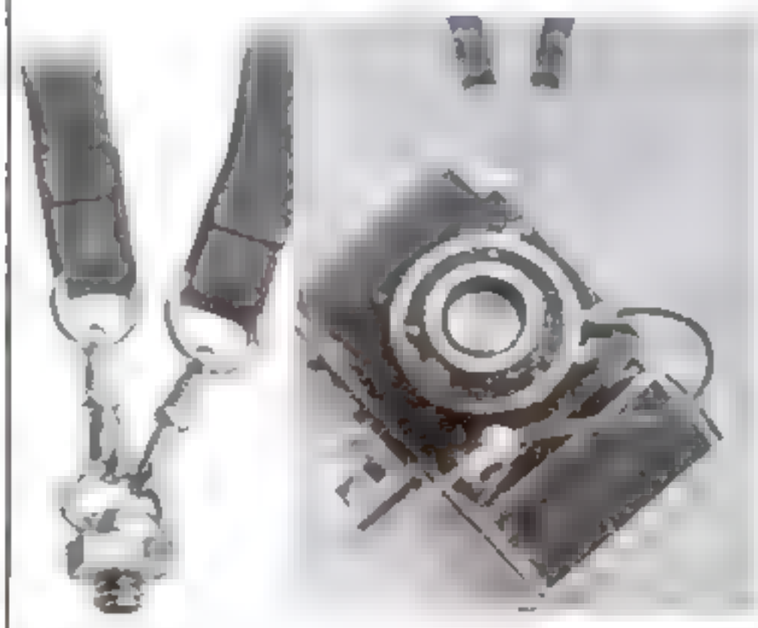
An excellent hood can be made from a ten-cent aluminum funnel. Measure the diameter of the lens cell and cut off the small end of the funnel so that the shade will fit loosely. Place the smaller opening around a pipe and pound it out to form a narrow flange. By coating the shade with olive oil and holding it over a hot flame, it will at first smoke and then take on a durable black glossy finish. Give the inside a coat of black wallboard paint or other dull black finish, and line the inside of the flange with a strip of velvet, using waterproof casein glue to hold it in place permanently.—K. L. Robbins.

The oil-coated metal turns a glossy black

For a more elaborate collapsible lens hood, see P.S.M., Feb. '36, p. 80.

NECK-STRAP ATTACHMENT FOR SMALL CAMERA

When using a miniature camera for so-called "candid" photography, it must often be ready for split-second shots and instant concealment when the work is done. Getting even the most compact midget camera from a pocket quickly is difficult, and a fumble can cost dearly in repairs. If, however, it is slung from a strap around the neck, the small camera is easily concealed beneath the coat and readily *(Continued on page 87)*



NECK-STRAP ATTACHMENT

(Continued from page 86)

brought into play; also, the hands are left free between exposures.

Most of the less expensive miniature cameras have no built-in features to which a neck strap can be hooked, and the camera body is usually of such thin metal that it is inadvisable to attach a pair of rings. Instead, the tripod socket, usually fitted with what is known as "American thread," can be utilized to hold a single ring for attaching a neck strap.

Cut the end from a common stove bolt with a ¼-20 thread to leave about ¼ in. projecting after this threaded end is screwed into the tripod cavity. A 1/16-in. lateral hole then can be drilled to insert a ring. A neater job results, however, if the free end is capped with a nickeled hexagonal nut secured with a drop of solder and the ring hole drilled through this. The threaded end cut from the stove bolt should be long enough to go fully into the tripod socket and yet be short enough to allow the hexagonal nut to fit tightly against the edge of the socket to keep the device from working loose.

A good neck strap can be cut from a woman's discarded belt. A strip of narrow leather belting or a dog leash from the "five-and-ten" does almost as well. Three screw eyes, their points cut off with a hack saw, will serve as the rings if no others are available. Two are sewed to the ends of the neck strap with beeswaxed thread. Hooks to connect them with the main ring can be salvaged from cheap or discarded jewelry.

Sometimes both the finger and cable shutter releases are in unhandy places on cameras of this type. A more convenient release can be made by tapping holes both in the front plate of the camera and any small nickeled knob (the one pictured held the bell on an old-fashioned alarm clock), and attaching the knob with a beheaded machine screw. A lateral hole is drilled in the knob and enlarged with a rat-tail file to accommodate the tapered shank of a short cable release. The shutter can then be operated by easy downward pressure of the forefinger without any fumbling.—WILFRED B. TALMAN.

PLYWOOD EDGES HIDDEN BY CELLULOSE RIBBON

WHEN plywood is used for making trays and similar articles, the edges can be neatly finished without additional trim by covering them with cellulose ribbon of the required width. Sand the edges smooth and square before gluing the ribbon in place, and hold it under pressure until dry. After one or more finishing coats of varnish or lacquer, the ribbon, if of the usual striped variety, will have the appearance of a band of colored inlay.—K. L. R.

AIR PRESSURE CLEANS TYPEWRITERS QUICKLY

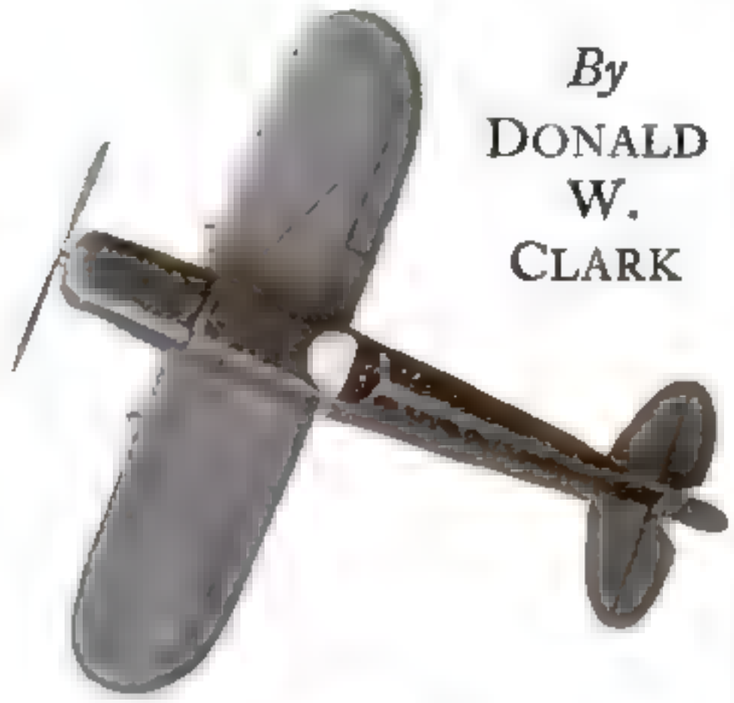
AN AIR compressor is one of the most effective devices for cleaning a typewriter in a schoolroom, office, or home. Use a bent brass nozzle about 6 in. long, ½ in. in diameter, and with an opening of about ¼ in., and apply a pressure of from 35 to 40 lb. of air. By blowing this through both the top and the bottom of the machine, a very thorough job can be done. Not only every bit of erasure material and dust is blown out, but any excess oil is atomized and distributed more evenly throughout the machine.

This method has been tried on forty-five typewriters in one school, and has worked miracles with machines that had become not only clogged, but sticky in various working parts.—MILDRED NUECHTERLEIN.

Racing Plane Model

REQUIRES ONLY TWELVE PARTS

The various units ready for assembly. The top view of the model is shown at the right



By DONALD W. CLARK

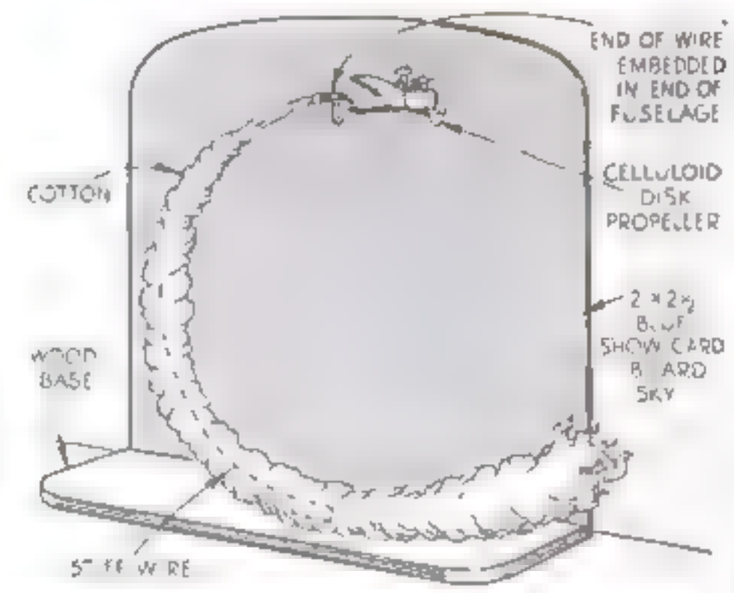
THE National Air Races have made small racing planes exceedingly popular so, for this month's model, we have chosen a trim little speed plane made in California and known as the Brown special racing plane. The span is 16 ft. 8 in., and the maximum speed is 240 miles per hour.

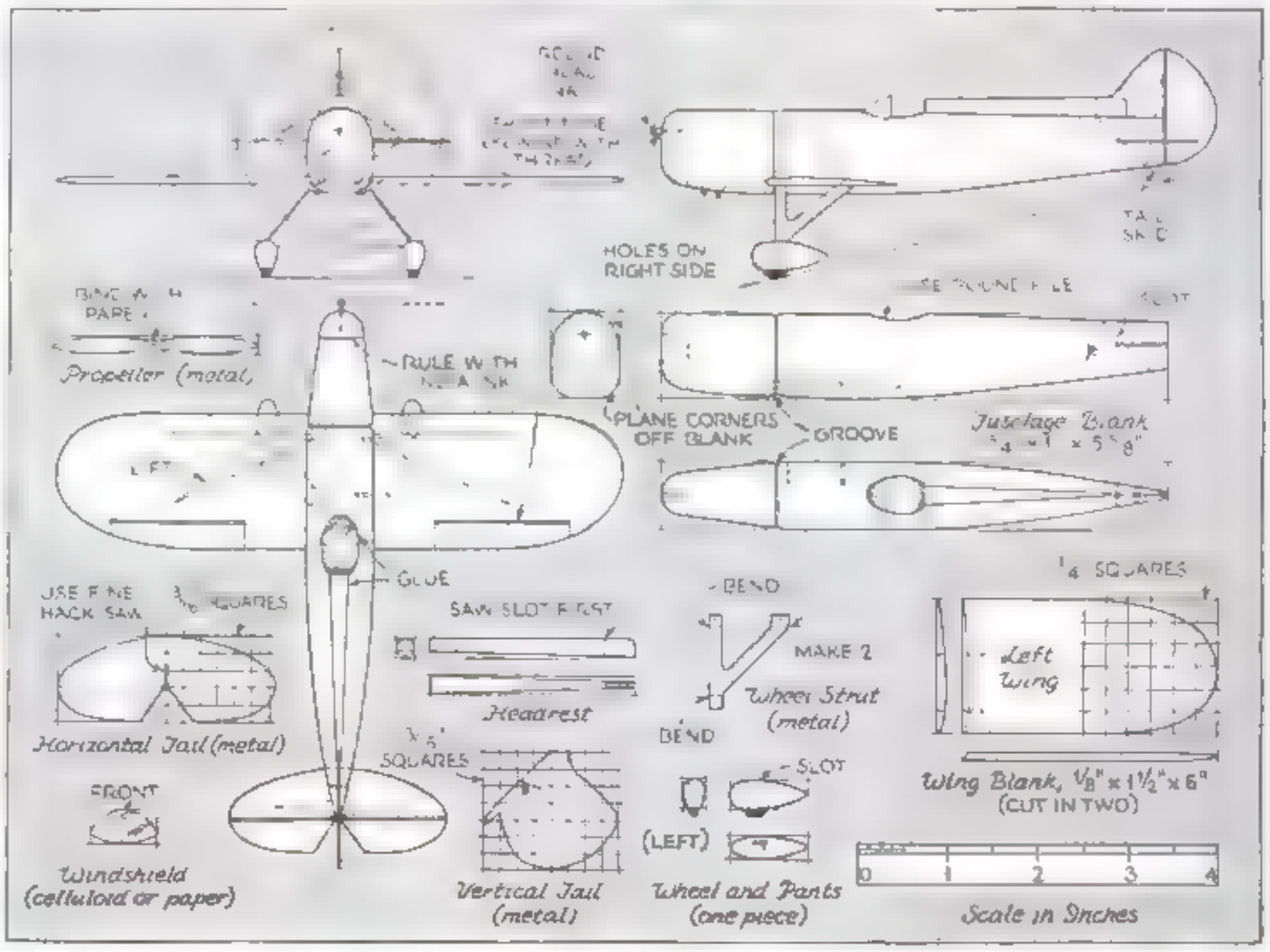
The scale of the model as compared with the real racer is ⅜ in. equals 1 ft., which makes it 6¼ in. long. Only twelve pieces are required, and practically all of them are easy to make. Shaping the wheel pants calls for the most care because they are so small that it is difficult to hold them, but a little patience while cutting and sanding will give the desired result. Mark the profile of wheel and pants on the blank and saw out with fine-toothed coping saw. The next step is to cut it to the shape shown in the top-view plan. Then, with a sharp knife, whittle away the corners enough to give the proper contour. Finish with medium and then fine sandpaper. The wheels can be made separately and glued on, but it is just as easy to make them integral with the pants.

The slot in the rear end of the headrest should be sawed in before tapering the blank. Fasten the headrest on with glue.

The parts can be painted and then assembled or, if preferred, the painting can be done after the plane is completely put together. The color scheme suggested is as follows: fuselage, vertical tail, struts, and pants, light brown; wings and horizontal tail, cream; tires and trim, black; propeller, polished metal.

One of the drawings shows an unusual way to mount the plane so that it appears to be making a spectacular turn against a clear blue sky. By carrying this idea a little farther and making a frame for the cardboard, the mounting would be suitable for display purposes on a mantel or elsewhere. The propeller should be replaced by a celluloid disk.





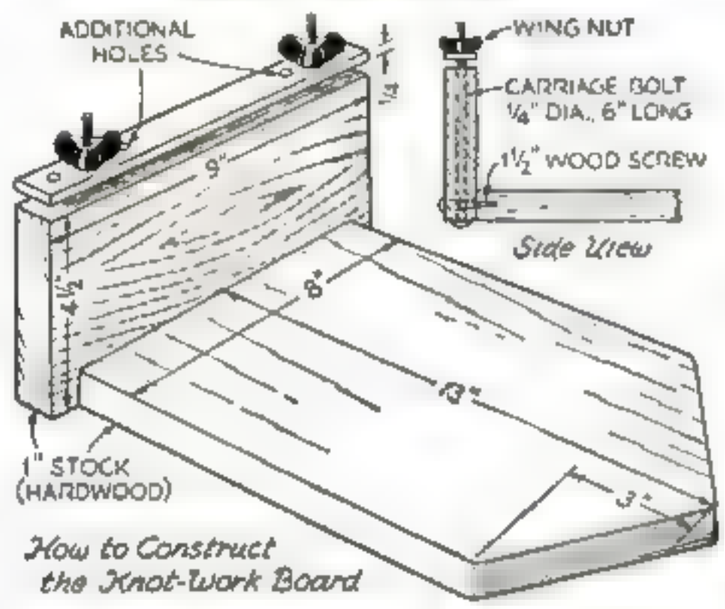
Assembly views and details of all parts. These drawings are one third the dimensions of the model

SHORT CUTS IN DOING SQUARE-KNOT WORK

SQUARE-KNOT work can be done with greater ease and rapidity by observing the following suggestions:

The cord is left by most workers as it is cut, but much time is wasted by having to pull the long cords through during the process of tying each knot. If the cords, after having been cut into the desired lengths, are chained with the chain stitch shown in the accompanying drawings, it will be found a great timesaver because this shortens the cords and prevents them from tangling. The loops should not be over 2 in. long, and after the cords are chained up as

Sample of Chain Stitch



How to Construct the Knot-Work Board

Device for holding the ends of cords during the knotting, and a cord-shortening stitch

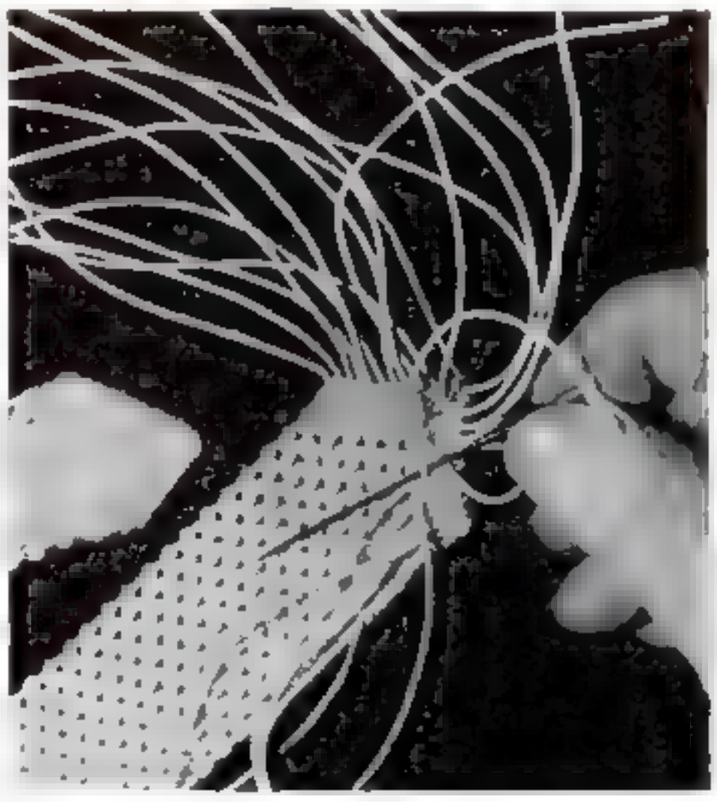
close to the work as desired, a half hitch is placed over the top of the last loop and drawn tight.

The knot-work board is made of 1-in. material (preferably hardwood) and has an adjustable clamp on top that may be changed to accommodate any size article. The board may be held on the knees or placed on a chair, table, or any convenient place.

It does away with the laborious method of working from a cord attached between two nails, pushpins, or like devices.

A smoother and more lasting ending of an article may be had by using a large darning needle to sew the ends (after the end of the article has been finished with half-hitches) instead of using liquid cement to fasten them. The ends of the cord on belts and other articles subject to friction do not always hold when merely fastened with cement. Sewing will bind the ends of the cord securely.

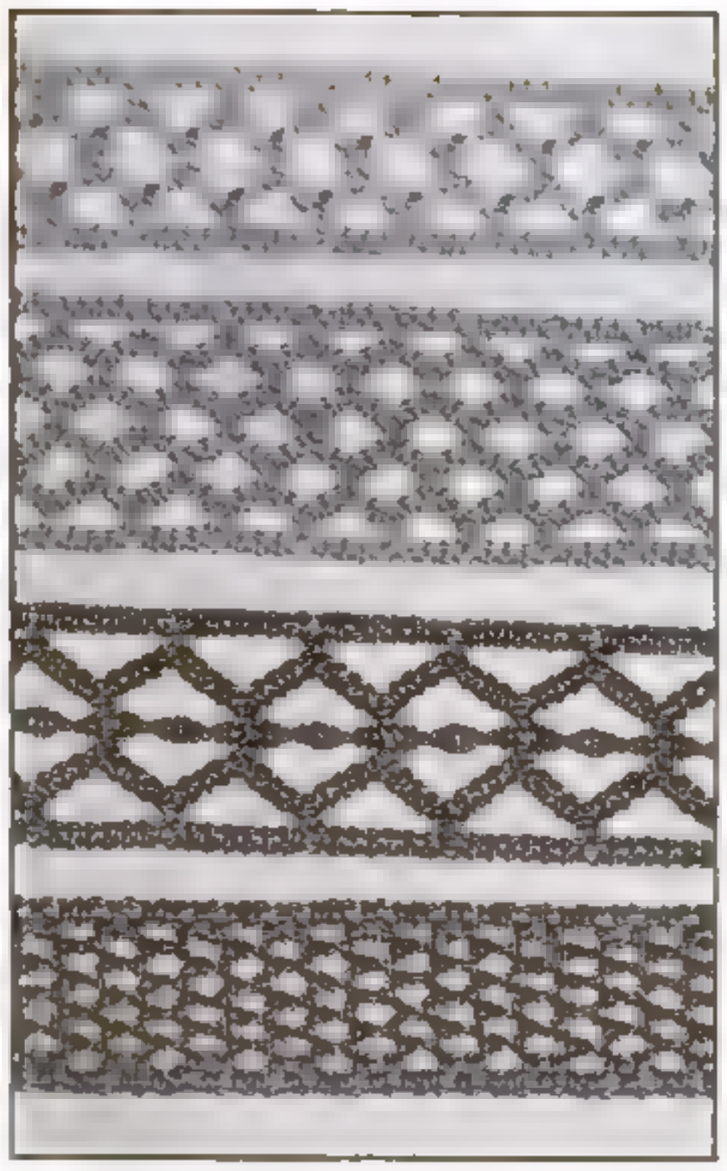
When a belt is being finished, put on two or three rows of *(Continued on page 90)*



After the article has been finished with the usual half-hitches, the ends are sewn back

SQUARE-KNOT WORK

(Continued from page 89)



Belt patterns to illustrate the variety of designs that can be made by square knotting

half-hitches, then thread the needle with the outside cord (the cords being used consecutively). Sew straight back from the end instead of across the belt, as this eliminates a bulge at the point caused by too many cords' coming together.

The sewing itself is done by pushing the threaded needle through the underside of the half-hitches as shown in one of the photographs, after which the ends may be cut off. If the cord has a tendency to shrink, the belt may first be washed by using a small brush with soap (soap flakes preferred) and water. After it has dried, the ends are cut off with a razor blade or a sharp knife.

The same method is used on any knot-work article where half-hitches are used and on many articles not ending in this manner. Sewing should preferably be done under two strands of cord, although one strand is sometimes sufficient. It gives a smooth, neat, and lasting end.

The four designs for belts shown in the illustration above may be of interest to knot workers and serve as suggestions for making original patterns.—NEALON VOTAW.

HOW TO PREVENT SINK STOPPER FROM COMING OFF ITS CHAIN

SINK and wash-basin stoppers become detached from their chains with annoying frequency. This can be prevented by spreading the two halves of the last link slightly apart and bending each end in at right angles toward the other about ⅛ in. from the end, so that the bent portions hold the two halves of the link permanently apart. Widened in this way, the link cannot slip through the joint of the stopper ring.—J. E. K.

BRASSY FLASH-LIGHT REFLECTOR REFINISHED WITH ENAMEL

WHEN a flash-light reflector becomes worn and brassy, it can be improved by enameling it a glossy white. Carborundum paper should first be used to clean the metal; then apply a coat of shellac and rub lightly again. Finish with one coat of flat white paint and one of white enamel.—ROBERT O. SHOPP.

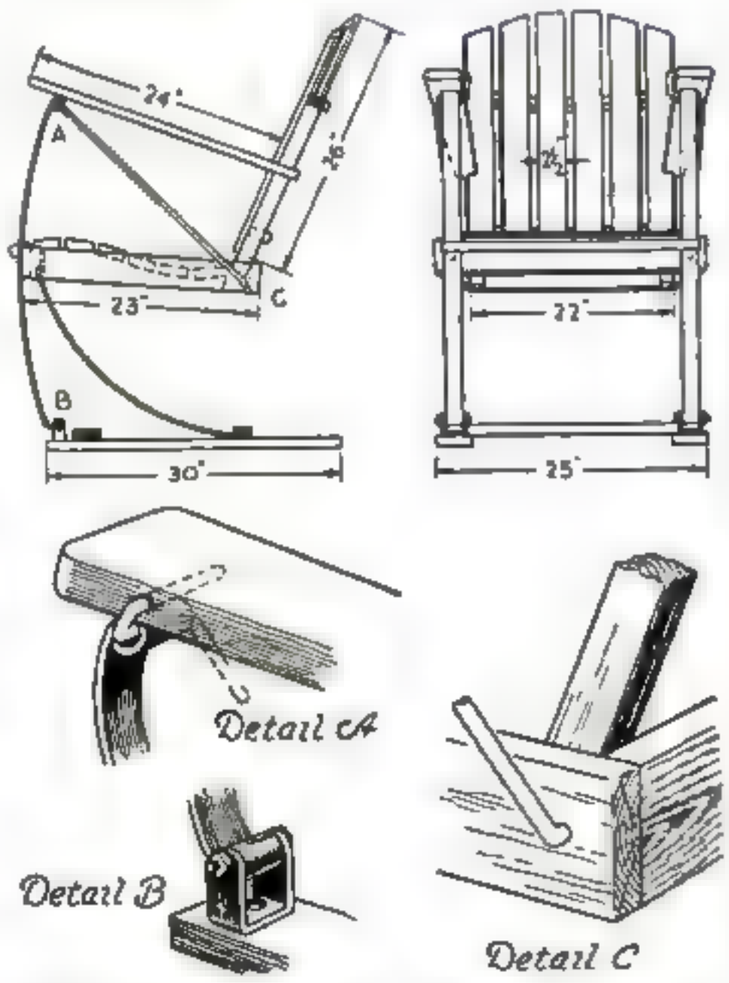
LAWN CHAIR SUPPORTED BY OLD AUTO SPRINGS

TOO many lawn chairs, while decorative in appearance, are hard, unyielding affairs. The modern spring-type metal chair is much more comfortable, and homemade chairs can be made equally so by using old auto springs.

Obtain from a junk yard four leaves from springs such as those on the front of a model-T Ford. The leaves you will need are the long bottom leaf and the short one with the eye in the end to which the spring clips are bolted for holding the leaves together. You will require two of each. While you are about it, get a pair of the clips, and if you don't have a couple of pieces of ¼-in. round iron rod at home, buy a brake rod, too.

The seat of the chair, as shown in the drawing, is built much like an ordinary lawn chair. Make a frame, wider at the front than at the back, and bolt on two upright posts, slanted back at a comfortable angle. Then lay out a couple of curved seat supports. The crosspieces in the back are also curved so that the back will be more comfortable. The slats for the back are made of thin material such as the boxes in which window glass is shipped. The seat slats are of ¾-in. thick crating, as is also the rest of the frame.

The base for supporting the chair is made of four pieces, as shown. The spring clips are bolted to the front end of the feet, and then the long spring leaves are fastened to them with a bolt through the eye on the end of the leaf. These leaves have a small hole through the center, and a bolt *(Continued on page 92)*



Side and front views of the chair with the principal dimensions, and details of joints

SPRINGY LAWN CHAIR

(Continued from page 91)

is inserted through this hole and also run through the front of the seat frame. An iron plate is put on, and then the nut is tightened. This plate keeps the bolt from tearing through the front of the seat frame.

The brake rod is now cut in two pieces, and a right-angle bend is made at each end of each piece. One end is driven into a hole bored in the side of the seat frame near the back, and the other end is hooked into the eye on the top end of the spring. These rods support the back of the seat and throw that weight on the long springs in front.

To hold the chair from falling backward, one end of the short leaves is fastened to the foot against the back crosspiece, and the other is fastened under the seat at the front, where the seat is bolted to the front spring.

The arms are of the usual shape and attached to the back posts by screws. At the front, U-shaped pieces of iron rod are used. One end is driven into a hole in the edge of the arm, and the other is driven into the eye on the end of the long spring leaf.

When you sit down, the short brace springs cause the front springs to bend in the middle at the same time the tie rods are pulling back on the top ends. This action is similar to that of a bow when the string is drawn back. The seat will rock up and down with an easy springing motion.

Of course, it must be painted to protect it from the weather and to give it a good appearance. A combination of green and pekin orange is one of the popular finishes in use on such furniture at the present time, but you may prefer other colors.—D. C. MARSHALL.

BLUEPRINTS TO MAKE YOUR WORK EASIER

YOU can double the pleasure you get out of your home workshop by using care and discretion in choosing worth-while projects to make. Whenever you are in doubt as to what to build next, consult our blueprint list. The following is a selected list, but many other plans are available. Send a self-addressed, stamped envelope for our complete list.

FURNITURE

Chests, Treasure, *78*	.25
Coffee Table with Spiral Legs, *245A*	.25
Double-Decker Bed for Boy's Room or Cabin, *277A*	.25
End Table, American Empire, *241A*	.25
Fireside Seats (wood and metal), *266A*	.25
Floor Lamp with Tripod Base, *243A*	.25
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Mirror Frame, 20 by 30 in., *246A*	.25
Pier Cabinet and Hanging Shelves, *77*	.25
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Smoking Stand, Modern, *238A*	25
Stool, Scoop-Seat, *242A*	25
Stool, Upholstered, *240A*	25
Table, Four-Leaf Card, *239A*	25
Tables, Tile-Top, *249A*	.25
Tavern Table and Scroll Mirror, *105*	.25

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 84.)

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Civil War Ships *Monitor*, *Merrimac*, and *Hartford* (3½, 5⅜, and 5⅛ in. long respectively), *258*	.25
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper Ship *Great Republic* (31½-in. hull), *272-273-274*	1.00
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Brooklyn* (8-in.), *236*	.25
Cruiser *Tuscaloosa* (11¾-in.), *234*	.25

(Continued on page 93)

SELECTED BLUEPRINTS

(Continued from page 92)

Freighter, Ocean (14-in.), *271*.	.25
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33⅛-in. hull), special prints *221-222-R*	1.50
H. M. S. *Bounty* (8½-in. hull), *254*	.25
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Motor Boat, 29-in. Cruiser, *63-64-R*	.75
Motor Boat, Working Model (20-in.), *196*	.25
Nourmahal, power yacht (8⅛-in.), *276*	.25
Liner—*Aquitania* (9-in.), *225*	.25
Liner—*California* (12½-in.), *251*	.25
Liner—*Normandie* (20⅝-in.), *264-265*	.50
Liner—*Manhattan* (12-in.), *204*	.25
Liner—*St. Louis* (11-in.), *231*	.25
Pirate Felucca (20-in.), *44-45-R*	.75
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Roman Galley (19-in.), *138-139-R*	75
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Show Boat, Illuminated (14-in.), *263*	.25
Stagecoach with Horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19⅛-in.), *94-95-96-R*	1.00
Trading Schooner (17½-in. hull), *252-253*	.50
"Treasure Island" *Hispaniola* (7-in.), *237*	.25
Viking Ship, (20½-in.), *61-62-R*	.75
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

TOYS

Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Projector for Photos and Pictures, *259A*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Five-Tube Short Wave (A.C. or D.C.), *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

BOATS

Camper's Boat, 11 ft. 2 in. long (can be rowed or used with outboard), *281*	.25
*Canoe, 16-ft. Canvas-Covered Kayak, with sail, etc., *192-193-194-R*	1.00
Duck Boat, Canvas Covered (13 ft. 6 in. long; weighs 60 lb.), *279-R*	.50
*Duck Boat, Folding (13-ft.), *170-R*	.50
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Installing Inboard Motors, *270*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50
*13-ft. Racing Runabout, *261-262-R*	.75

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

MISCELLANEOUS

Brass Porch Lamp, Marine Style, *280A*	.25
Hand Loom, Four-Treadle, *268A-269A*	.75
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Radiator Inclosures, *278A*	.25
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GREAT REPUBLIC MODEL

(Continued from page 75)

double block in its end, which connects with a double block in the deck; the hauling part goes through a single block, bolted to the deck, and up to the pinrail.

The lifts are spliced into the yardarm eyes and go through the crosstrees, under the rigging. These and all other lifts should by rights have eyes in their upper ends and be lashed to the rigging at the mastheads.

An upper topsail brace starts at the heel of a single block strapped to the end of a small chain pendant, 1 in. long, at the yardarm. It then reeves through a block seized to the eye of the cap stay, back through the yardarm block, and down through a block bolted to the chock and up to the pinrail. The mizzen upper topsail braces are the same, but have their upper blocks on the spanker topmast stay.

THE lower topsail-yard lifts are spliced to the yardarm eyes and have eye-splices at the other ends, which are seized to the cap-stay bolts. The halyards are of small chain. They start at the eye on one side of the lowermast, under the cap; reeve through a gin block on the yard; and pass up over a sheave in a cleat on the other side of the mast. A cord is spliced into the end of the chain, which leads down through the top to a double block with a purchase, similar to that on the upper topsail halyards. The eye will be to port at the fore and reverses at each mast. The braces are rove the same as the upper topsail braces to their respective positions.

In place of a halyard, a lower yard has a chain sling. This shackles to the center of the yard and to a bolt in the mast, close under the top. I got these snug by boring two small holes in the mast, passing a wire through the end link of the carefully measured sling, drawing the wires tight, and twisting them abaft. The lifts are called "topping lifts" because they are tackles by which the yard can be topped. The normal lead for these is to the masthead, but with the Forbes rig they will not lead there, so I took them to pendants seized to the lowermasts above the rigging. The pendants have double blocks to lie just beyond the edge of the top. The hauling parts come down through sheaves in the topsail sheet bitts and there belay.

The fore and main braces have long chain pendants with double blocks connecting with single blocks strapped to eyes in the channels and other single blocks on the chock

The mizzen lower and topsail braces, instead of leading through blocks on the chock, go to blocks fastened with short pendants to the bumkins.

THE spanker boom needs two sheets of double blocks, shackled to the runner under the boom, and single blocks, which are bolted to the deck at either side. The topping lifts seize to the boom end; the two parts lead through blocks under the trestletrees and have single blocks in their lower ends.

The gaff should have a small chain span, as shown on the rigging plan, and vangs fitted like the lifts, in reverse.

The upper gaff has a cord span from the masthead and single cord vangs, hitched to the crosstrees.

The blocks aloft will all be black, and those on deck and on the chock, white. All the chain is black.

The rudder should now be shipped and a small chain seized to the eye projecting from it. The chain runs to an eye on either quarter and to the aftermost chain plates.

The model should carry the 31-star ensign of 1853. At the time the ship was burnt she was under charter *(Continued on page 95)*

GREAT REPUBLIC MODEL

(Continued from page 94)

to Grinnell, Minturn & Co. and was loading for Liverpool, so I gave my model their Liverpool Line house flag and the British ensign as a courtesy flag. The house flag is as shown on the rigging plan, the colors being blue (next to the staff) and white.

There were no navigation lights at that period.

This seems to be all, except that I wish to call attention to one fact that the spanker topmast is on the foreside of the lowermast. On the main rigging plan it was inadvertently shown abaft the lowermast, although it appears correctly in a detail drawing and in the photographs.

A few notes on the subsequent career of the *Great Republic* should be added. After the fire, she was refloated by the insurance underwriters and from them bought by A. A. Low & Bros., who rebuilt her at Greenpoint, N. Y. The upper deck was not replaced, leaving her with three decks, poop, and forecastle, and reducing her tonnage to 3,356.

Her rigging was reduced about 15 percent, and she was fitted with Howes' double topsails. Her crew was cut down correspondingly to 50 men.

She was still a fast sailer and made the best time on record from Sandy Hook to the line (equator)—15 days, 18 hours. She traded to England, and in 1857 made the trip from New York to that country, land to land, in 12 days. She was then chartered to the French Government and later, while in the Californian trade, made a passage of 92 days from New York to San Francisco.

In 1865 she was laid up for a year and then sold to Yarmouth, N. S. In 1868 she was sold to Liverpool for about $17,500 and renamed *Denmark*. On March 5, 1872, she foundered in a gale in the Atlantic, all hands reaching Bermuda in safety.

HOW TO TEAR FRICTION TAPE FROM A ROLL

The needed length is creased at right angles and torn sharply along the edge of the roll

AN EASY method of tearing a piece of friction tape from a roll is to double over the desired length of tape at right angles to the roll at the point where it is to be torn off, as illustrated above. Then, by pressing downward with the thumb as close as possible to the edge of the roll, it is a simple matter to tear the tape. Another advantage is that the end of the roll, being creased over, will be easily distinguished.—J. ERNEST KESSLER.

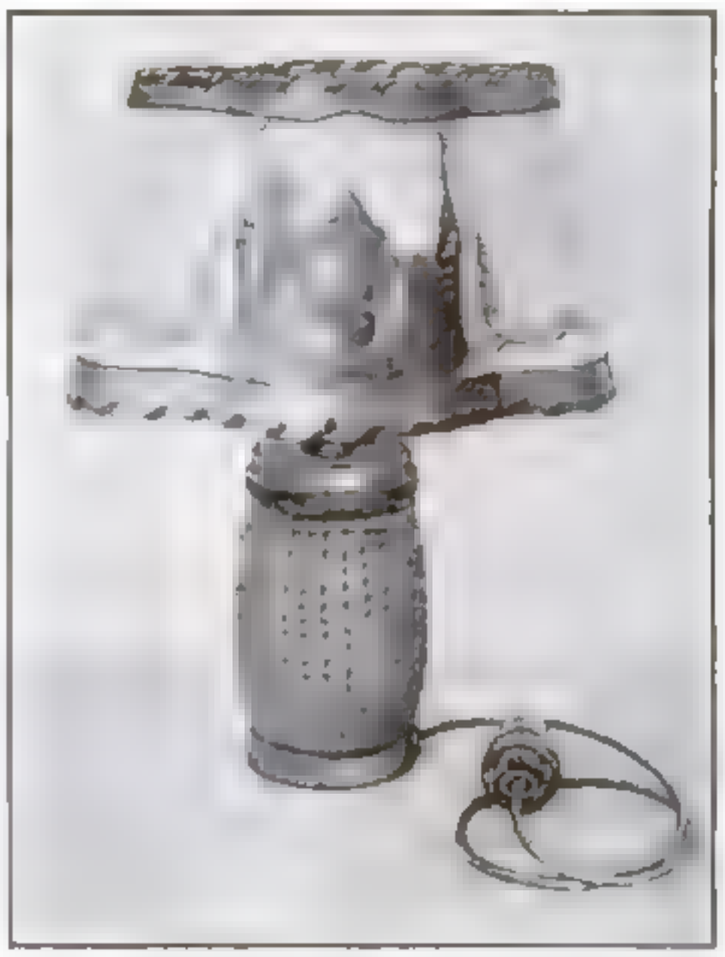
HOLDING PIPE FOR THREADING

IN THE absence of a pipe vise, a short section of conduit or other pipe can be held for threading by placing it vertically in a machinist's bench vise and catching the pipe with a pipe wrench beneath the jaws of the vise. Tighten the jaws only moderately; the wrench will bear against the vise and prevent the pipe from turning.—L. N. G.

WOVEN LEATHER COVERS PEANUT-JAR LAMP

THE decorative, leather-incased table lamp illustrated below is made from a barrel-shaped peanut jar. It is covered with woven sheepskin, suede side out.

Place the jar on the bench, bottom up, and with a nail set drill a 3/8-in. hole through the bottom by tapping lightly with a hammer and

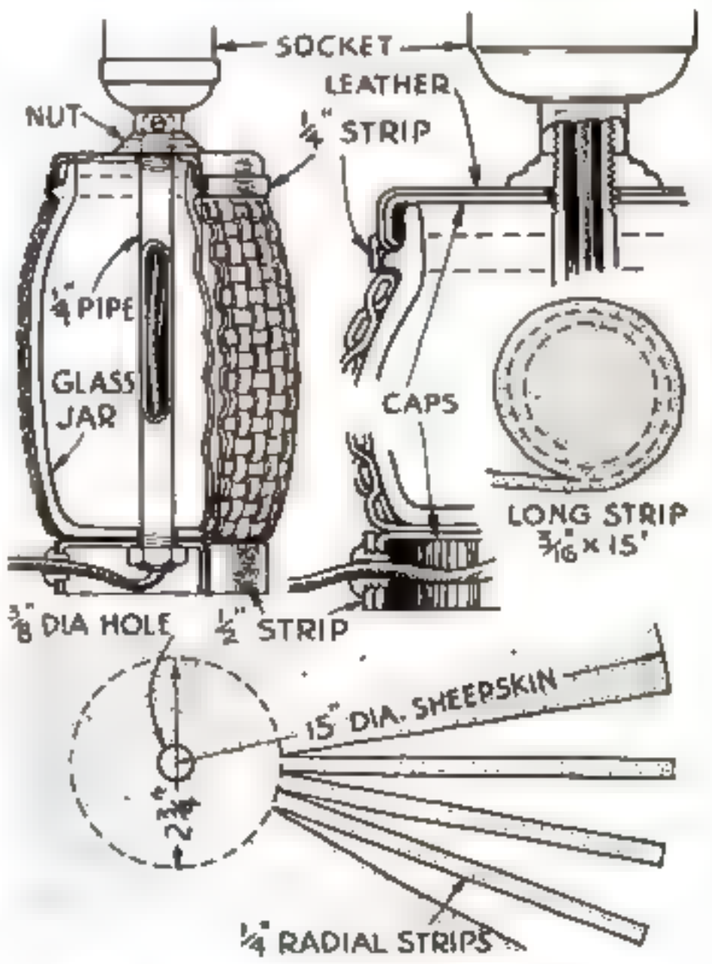


The standard of this lamp is a barrel-shaped peanut jar concealed by woven leather strips

gradually chipping the glass away (or drill the hole by any of the various methods used in working glass).

Cut a 15-in. disk from the leather, then lay out and cut 1/4-in. radial strips all the way around as shown. Cut another strip 3/16 in. wide and about 15 ft. long by cutting around and around another disk. Place the jar in the center of the 15-in. disk and begin weaving. Run the long strip over and under the uprights, and continue on up to the shoulder of the jar; then run around once. Cut the upright strips off evenly, bend them down over the last weave, and glue them fast.

Drill a 3/8-in. hole in the jar cap. Get another similar jar cap for the base and drill it in the same way; also drill one 3/8-in. hole in the side of it. Wet *(Continued on page 97)*



How the sheepskin is cut, method of assembling the lamp, and details of base and top

Old Bill SAYS:

WHEN a milling cutter chatters, try slowing down the machine spindle speed. The teeth of the cutter may be synchronized with gear teeth of the machine at the particular speed the spindle is running.

* * *

Never attempt to drive or press a bushing into a hole if it is possible to draw it into place by inserting a threaded bolt through the bushing and part to be bushed and taking up on a nut at the opposite end.

* * *

For precise measuring with a steel scale, accustom yourself to make measurements from the one inch graduation. The ends of scales wear and cause inaccuracies when used as the initial gauging point.

* * *

A few small gauges of the most common angles will be found convenient. They can be used in places not accessible to the ordinary bevel protractor.

* * *

Make counterbore pilots from machine steel and caseharden them. They will then possess a hard surface to resist wear, and a tough core to keep them from snapping off. When they do break, the broken portion remaining in the counterbore, being soft, is readily removed by drilling.

WOVEN LEATHER LAMP

(Continued from page 96)

two small disks of the leather and stretch one over each of the caps until it fits. Trim the edges and glue it on. Then place one cap on the jar and glue a ¼-in. strip around the lower edge as shown. The other cap is used for the base. Glue a ½-in. strip around this.

Run a ¼-in. threaded pipe through the base and up through the jar, and tighten a nut on each end. Place a ⅜-in. fiber bushing in the side of the base, and attach the socket.—D. HUTCHINSON.

The jar cap is covered with leather neatly shrunk on, and a similar cap forms the base

EMERGENCY LIGHTS FOR MODEL RAILWAY

IF ALL the car lights go out when you stop a model railway train at a station, it spoils the realistic effect. One remedy is to use dry-cell batteries to light the cars, but it is rather expensive. A solution that will have a greater appeal for enthusiastic model builders is to install an emergency lighting system like that used in full-size modern electric trains.

Figure 1 shows the arrangement of parts. When the train is running, current flowing through the regular car light also flows through the coils of the magnet and keeps piece *B* from making contact with contact *C*. When the current is shut off to stop the train, the regular light goes out as usual and instantly the magnet releases piece *B*, which drops by its own weight against contact *C*, completing the battery circuit through the extra flash-light bulb so that the car stays lighted.

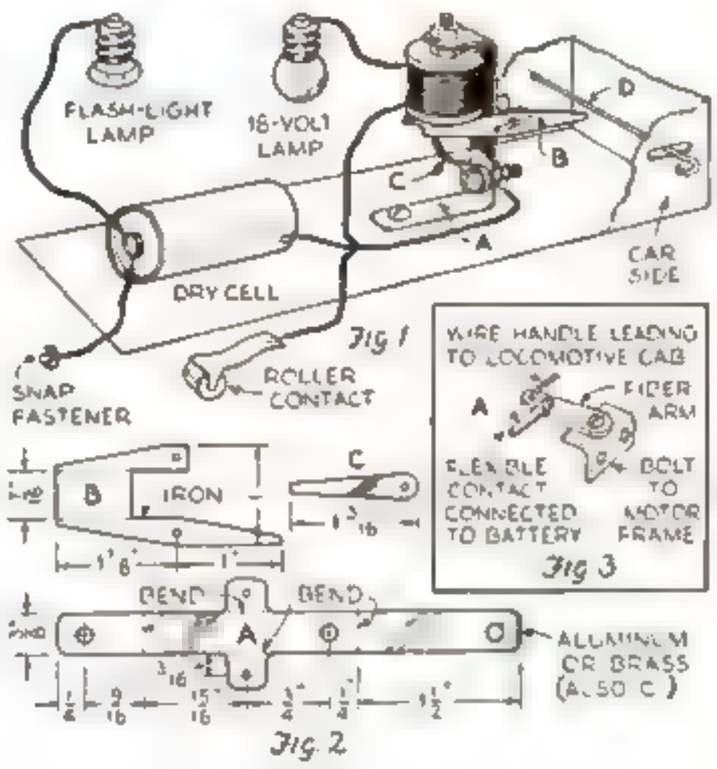
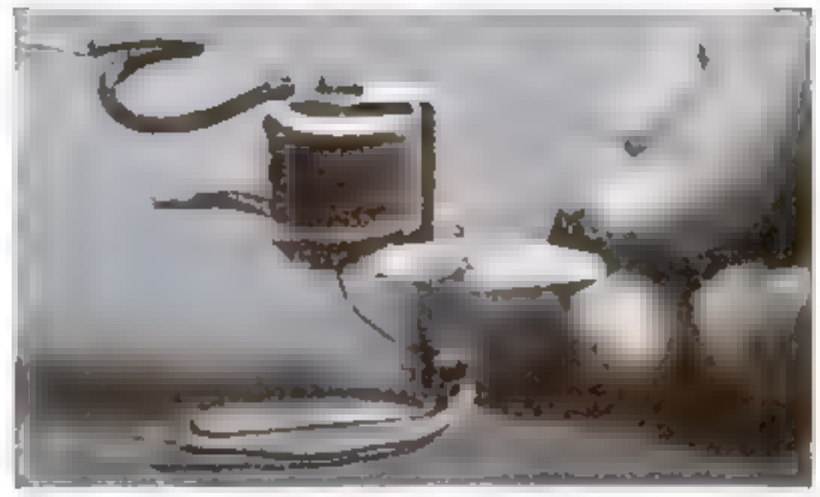


Diagram of special lighting system, the main parts of the relay, and an alternative device



When the regular car light goes out, the magnet releases an arm which switches on an emergency lamp

The parts of which the relay is made are shown in Fig. 2. The bolt used as core for the magnet and the swinging contact *B* must be made of iron; the rest may be of brass or aluminum. Fixed contact *C* is insulated from the frame piece with insulating washers.

Part *D*, Fig. 1, is a sliding lock to hold the moving contact in open position when the train is not in use. If preferred, the same result can be obtained by fitting a switch in the dry-battery circuit.

This unit may be made for each car, but you can save a lot of work by making just one for each train and then wiring the cars together in such a way that several cells in parallel located in the same car with the control will also light the flash-light bulbs in all the other cars of the train. If desired, the cars may be wired together with snap fasteners on the wires or by fitting a radio pin jack and plug to the wire ends.

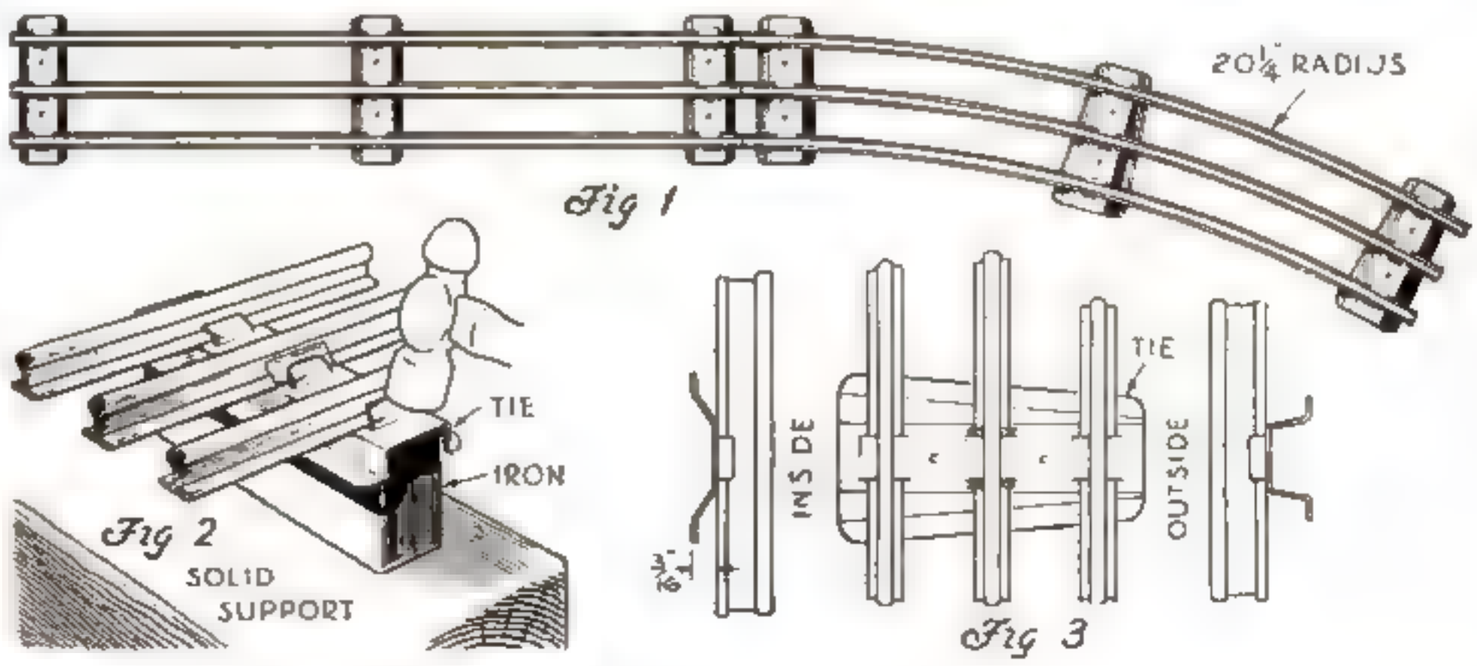
Figure 3 is a suggestion for accomplishing a similar result by making an attachment to be operated by the cut-out switch that some "remote-control" locomotives have. Arrange the device so that the pivoted plate in the motor touches *A* as well as the reversing contact. *A* must be as flexible as the latter or the remote control may be prevented from operating.—HAROLD V. LOOSE.

LONGER CURVES IMPROVE TOY TRACKAGE

AS EACH year rolls around, most model railway enthusiasts find their trackage increasing. To get better operation of the trains, the curves can be made larger so that three curved sections instead of two may be used at each turn. Trains run smoothly and less power is required. Only two easy changes need be made.

First, make a template on a board at least 5 by 22 in., as shown in Fig. 1. Now, using a screw driver, pry up the clips on the center and the right tie of a curved section so they may be removed, which leaves the rails free. Lay the straight and curved sections on the pattern and bend the outside rail a little at a time, starting at the junction of the two sections and working out. When the outside rail fits the new curve, start bending the center rail and finally the inside rail. After all three have been bent to fit the new curve, slip the center tie back on the rails and, with the screw driver, bend the clips down on the rails; then do the same with the end tie. Be sure to put the fiber insulation on the center rail as before. With a piece of iron under the center of the tie, hammer the clips firmly on the rails, as shown in Fig. 2.

The center rail will now be 1/16 in., and the outer rail ⅛ in., too long. This can be sawed off with a fret, jig, or hack saw. Finally the ties of the curved sections are bent as shown in Fig. 3 to grade the *(Continued on page 99)*



LONGER TRACK CURVES

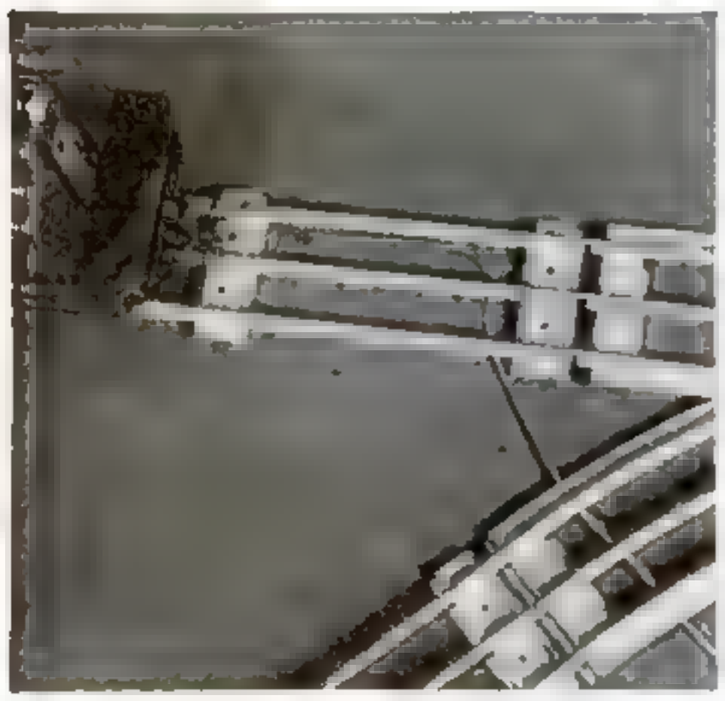
(Continued from page 98)

curves so the trains will lean in and glide around without any jerky motion.

When these modifications have been made, scale model locomotives and cars can be used, which is impossible with the shorter curves as now manufactured.—O. E. PUTNAM.

MODERNIZING ELECTRIC RAILROAD SWITCHES

ELECTRIC switches for model railroads are now made so that a train approaching on the straight or curved branch will automatically set the switch so that there will be no derailment. This has been accomplished, in the modern switches, by insulating part of the running rail so that as the locomotive approaches, it grounds this portion and allows



A contact of corset steel or wire is set to project slightly above the rails, and a suitable spring shoe is made for the locomotive

current to flow through the switch-operating solenoid just as it does when you press the regular operating button.

Insulating a section of the running rail is rather difficult for the model railway enthusiast, but the same result can be obtained by fitting an extra contact wire or spring near the running rail at the proper point, as shown, and then putting a simple contact shoe on the locomotive so that it touches the spring or wire.

Still older types of switches are wired so that the live wire applied to either switch terminal throws the switch. They also can be modernized in the same way. Use the same kind of fixed contact, but place it close to the third rail so that the locomotive contact roller will touch it as well as the third rail and allow current to flow from the third rail to the fixed contact.—DOUGLAS POPE.

ORDINARY BAR CLAMP APPLIES PRESSURE TO BREAST DRILL

FINDING it difficult to drill a hole through some soft steel with a breast drill, I used an ordinary cabinetmaker's bar clamp to apply extra pressure. The work was placed at the edge of the bench, and the breast drill set up in the correct position, with a rubber pad on the breastplate. The jaw at the adjusting-screw end of the clamp was set on the pad, and the other jaw was moved up to grip the underside of the bench directly beneath the work. The drill frame was wired loosely to the bar of the clamp to keep the drill upright. Then, while the drill was turned with one hand, pressure was applied by turning the clamp handle with the other hand.—R. T. FAUTZ.

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MAKING PILLOW BLOCKS OF BALL-BEARING TYPE

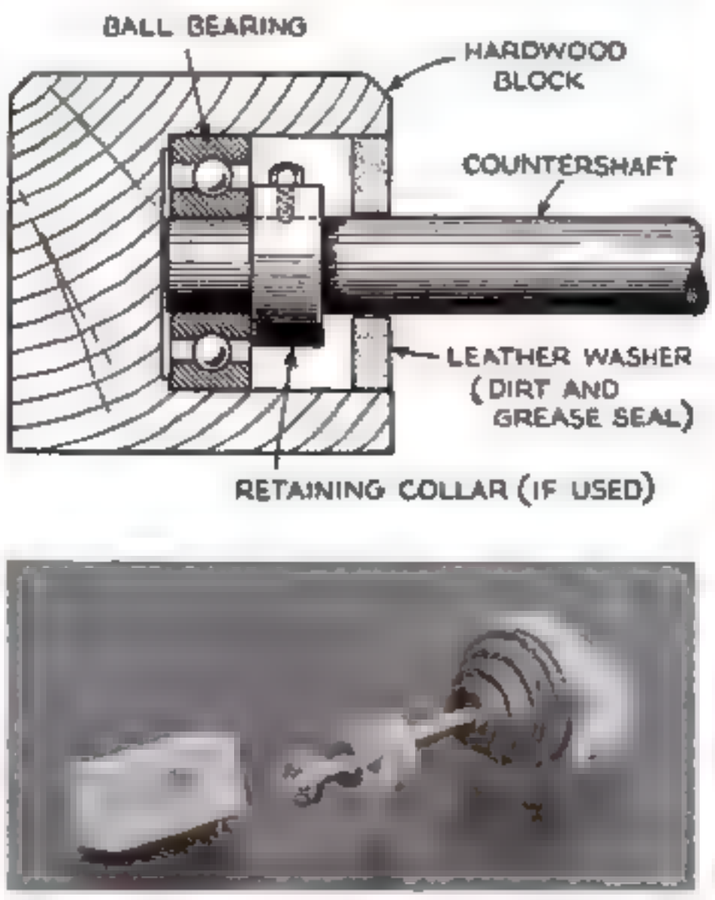
WHEN the home workshop owner plans the arrangement of a power-driven machine requiring a countershaft, he will probably look longingly at ball-bearing pillow blocks for the countershaft and then buy ordinary sleeve-type bearings in the interest of initial economy. He can, however, construct his own ball-bearing pillow blocks at a fraction of the cost of purchased units. A visit to any auto junk yard will enable him to acquire the necessary ball bearings themselves at a trifling sum, unless he prefers to use new bearings.

Countershaft for home workshop assembled with inexpensive ball-bearing pillow blocks

The bearing holders should be made of hardwood, such as maple or oak. Carefully measure the outside diameter of the bearing and then bore a hole exactly this size halfway through the block. This hole may be made in a variety of ways, but two good methods are to use an expansion bit or to fasten the block to a faceplate of a lathe and bore out the hole. It is essential that the bearing should fit this hole snugly to insure a smooth-running job.

If the diameter of the hole in the inner race does not fit the shaft, it should be made to fit, either by the use of a sleeve or by reducing the shaft diameter the required amount. Either operation requires lathe facilities, so, if possible, bearings should be selected that will fit the shaft diameter on which they are to be used.

One photograph shows the hole bored in the wood block and the ball bearing mounted on the shaft. Just back of the bearing will be noticed a leather disk. After the bearing has been pushed into its mounting hole, this disk of shoe leather, which has been cut to the diameter of the bore, is inserted and glued in the end to act as a dirt and grease seal. The hole through the disk for the shaft should be made the same diameter as the shaft to insure that the packing grease for the ball bearing is kept in while all dust and *(Continued on page 101)*



Partially disassembled countershaft and drawing to show typical method of mounting shaft

MAKING PILLOW BLOCKS

(Continued from page 100)

dirt are kept out. A seal made and mounted in this fashion gives a professional touch to the completed bearing.

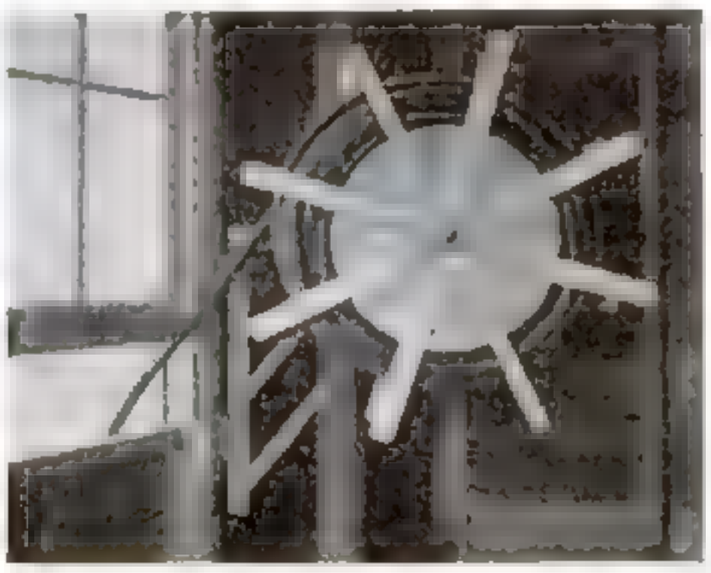
If the shaft fits the bearing hole exactly or requires the addition of a sleeve, a retaining collar should be used to prevent the bearing from sliding along the shaft. This collar will fit inside the wood block, back of the seal, so will be unseen. A shaft fitted to a bearing by turning down its diameter will have a shoulder formed on it which will serve as a retainer.

The photographs indicate only one of the many ways these pillow blocks may be constructed. Furthermore, the builder is not limited to the use of ball bearings; roller bearings may be mounted similarly.—J. L. Bird.

REEL INSIDE GARAGE KEEPS HOSE HANDY

ONE of the handiest gardening aids I have is the hose reel illustrated, and it also saves wear and tear on the hose. The outside faucet is located at the back of the house, just outside the garage window. It is therefore convenient to reel the hose in and out the window. When not in use, the reel lies flat against the wall, out of the way.

A reel of this type is made by constructing two disks of ¾-in. material, 15 in. in diameter, and nailing eight 1 by 2 by 14-in. spokes on the outside of each. Bore a hole in the center



The reel is swung out from the garage wall so the hose can be drawn through the window

large enough to take a ½-in. iron pipe (about 13/16 in. outside diameter).

Separate the two outside frames by setting four pieces 1 by 2 by 7 in. between them at regular intervals. A strip of galzanized iron is then tacked in place on which to reel the hose. Drive a piece of ½-in. pipe through the center of the reel, being certain that it does not extend at either side.

The bracket is made of 1½-in. angle iron, and the braces of 1-in. angle iron. The vertical arm is 20 in. long; the horizontal arm, 16 in. The joints may be brazed or riveted. A steel rod or bolt should be brazed or otherwise attached to the bracket to act as a spindle for the reel. If you do not work in metal, the bracket may of course, be made of wood.

The bracket is mounted on the studding by means of a pair of heavy loose-pin butt hinges. The reel is kept in place on the spindle by means of a cotter key through the end of the spindle.

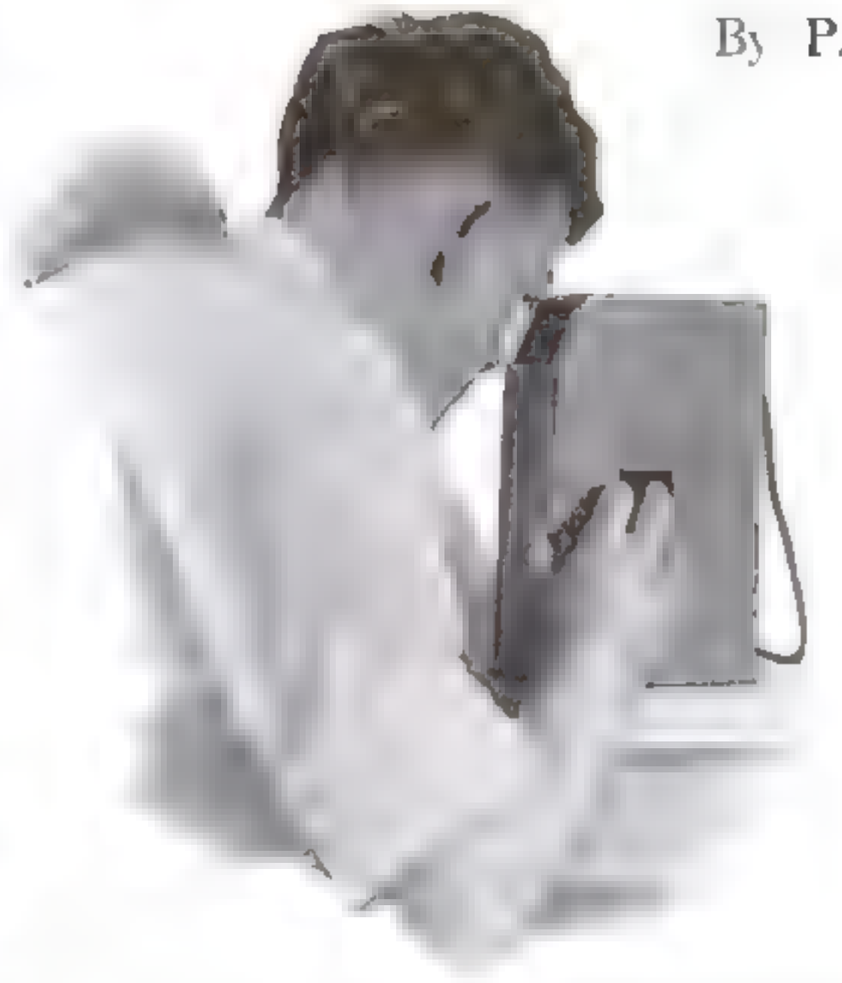
Be sure to mount the reel high enough that the fenders of the car will not accidentally strike it.—E. G. Livingston.

EASING RODS INTO CURTAINS

To make it less difficult to insert curtain rods into curtains, squeeze an aluminum thimble until it is flat enough to fit over the end of the rod.—C. L.

Home-Built Instrument REVEALS WONDERS OF Polarized Light

By P. RALPH DOWDEN



The specimen is inserted through a slot in the side of the polariscope and viewed through a window at the top

JUST remove the piece of mica from an ordinary fuse or the transparent cellulose wrapping from a cigarette package, place it on the specimen glass of this homemade polariscope, rotate the object slightly, and look through the glass window. You will see the specimen transformed into a mass of brilliant colors.

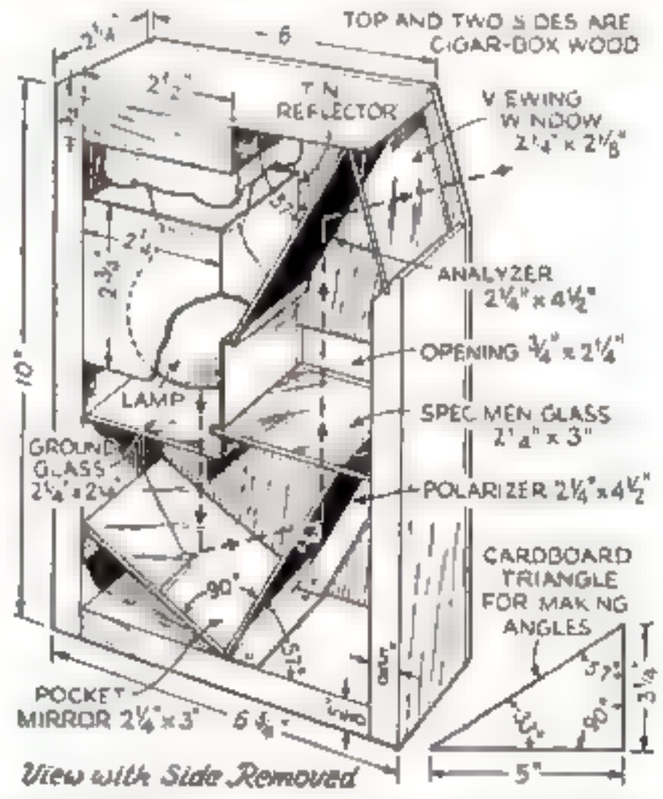
Polarized light—light waves vibrating in one plane instead of in all directions—when passed through certain substances is rotated through an angle that depends upon the wave length of the light used. When white light is polarized and passed through mica, for example, its color components are rotated various amounts, producing a colored effect. The thickness of the specimen controls the color produced, so that designs can be built up with pieces of different thickness. If several layers of mica or transparent wrapping material are rotated on the specimen glass simultaneously, the result is a continuous change of coloring.

The chemist uses a polariscope that is essentially a horizontal glass tube with Nicol prisms made from the clear transparent mineral Iceland spar, a pure form of calcium carbonate. A diagonal cut is made through the crystal, and the surfaces are polished and cemented together again with Canada balsam. Light passed through such a crystal gives two beams, each vibrating in a plane at right angles to the other. One ray is refracted to the side and is absorbed by the blackened walls of the tubular holder, while the other emerges from the Nicol prism as light vibrating in a single plane. Such light is said to be polarized.

In the instrument illustrated, pieces of glass blackened on the back with enamel and placed at an angle of about 57 deg. to a beam of light serve as Nicol prisms. One inclined mirror polarizes the light that passes through the specimen, while the other is necessary to view the resultant colors. The details of construction are given in the drawing.

A porcelain socket and a 15-watt lamp furnish the light. A tin reflector directs the light through a diffuser of 2¼ by 2¼-in. ground glass to a pocket mirror that throws the light onto the polarizer. The polarizer and analyzer consist of two pieces of thin picture-frame glass, each 2¼ by 4½ in., enameled black on the reverse side with about four coats or until they appear opaque when held to the light. Strips of ½ by 3/16-in. wood and tin supports are used as shown to hold the various pieces of glass firmly in place before the side of the box is closed. The top is removable so that the lamp can be taken out by withdrawing a wood screw from the block carrying the lamp socket. The interior walls are painted a flat black to prevent unwanted reflections. The outside is finished as desired, and a felt base completes the job.

Naphthalene, the substance commonly sold in the form of moth balls, if crystallized from denatured alcohol on a slide glass or other small piece of glass, will produce an interesting colored picture when viewed through this device. Tartaric acid used in the manufacture of Seidlitz powders can be crystallized similarly from water. Photographers' hypo is another substance for examination in a similar manner.



The polariscope with one side removed to show the arrangement of the various parts

CLAMP-TYPE TOWEL HANGERS MADE FROM CLOTHESPINS

NEAT towel hangers can be quickly made from ordinary spring wooden clothespins. Pull the clothespin apart, drill two small holes through the handle of one half, and nail or screw it to the wall. Push the other half of the clothespin back in place and enamel the whole green, cream, or any color desired. To use, press the handle and insert a corner of the towel between the jaws.—B. ROBERTS.

IDEAL CAMPER'S BOAT

(Continued from page 66)

insure perfect adhesion at every point.

Apply a liberal coat of glue at the keel lap, and attach the outside or bottom keel to the center of the keel with 1-in. No. 8 screws spaced 8 in. apart. This bottom keel prevents wearing the covering off along the keel.

The sheer moldings conceal the top edge of the cloth. Fasten these with 1-in. No. 8 screws.

A smooth finish for the canvas or cloth surface is had by mixing the remaining part of the glue with denatured or wood alcohol to the consistency of paint. This is applied to the cloth surface with a brush. When dry, sand smooth and apply two coats of flat color paint, followed by two coats of varnish. Sand lightly between coats and allow ample time for drying.

The remaining job is to attach the seats and floor boards. Fasten supports for the rear seat to the transom and frames with 1¾-in. No. 10 screws, and use the same size screws to hold the seats in place. Fasten the floor boards with 1-in. No. 8 screws. Saw oarlocks to shape and bolt each of them through the sides with two ¼ by 3½-in. carriage bolts.

Varnishing or painting the inside to suit will finish the job. A neat appearance may be had by finishing the seats "bright" with varnish and painting the interior, or the entire inside may be varnished.

For rowing, use 6½-ft. spruce oars.

BAMBOO OR WOOD SPLINTS KEEP SHOWER CURTAIN CLOSED

To PREVENT the curtain of a shower from blowing in toward the spray and letting water run out on the floor, put bamboo or pine splints in the seams. One long splint for each side and a pair of short ones for the top and bottom are all that is needed. Use a pair of sharp scissors to cut a hole to slide each splint into the seam. The holes are then sewed up and the curtain is ready for use. There is no need to fear the wood will warp excessively if the curtain is waterproof.—G. McCLELLAND.

MAKING A RAIN GAUGE

(Continued from page 61)

in., the ratio became 15.57, and a scale length of 15.57 in. was divided into 100 equal parts.

Lift off the receiver—and the center section as well, if you wish—and thrust the stick into the tube, holding it upright. Withdraw and read quickly, to the wetted portion. If much more than 1 in. has fallen, overflowing the tube into the reservoir, note the amount in the tube, empty it, and drain the reservoir into it, measuring and noting each time. Add the amounts, and you have the rainfall for the period since last reading.

With a little more work you can make this gauge record the rainfall automatically. Build a frame as shown in the bucket assembly drawing. Angle irons are notched to fit over the reservoir top and are joined by brass strips, bolted and soldered to them.

Make the bucket of lightweight brass or stainless steel, cutting the blank to shape and bending the sides up straight, with the bottom curved crosswise. Holding it in a clamp, solder in the partition. Solder across the center, beneath, a brass strap, as detailed in the drawing, and make the two brass trunnion cams, which are drilled ⅛ in. in diameter and soldered to the ends of the strap. Drill the holes on through the strap ends.

The contact-point assemblies make use of contact parts from Ford coils. Pry the steel springs from their mounts, snip off the surplus metal of the mounts, and attach them to the angle irons by means of small machine screws. These mounts are grounded, and to them the brass *(Continued on page 104)*

MAKING A RAIN GAUGE

(Continued from page 103)

contact springs are soldered.

Solder to the free ends of the springs, underneath, the contact points cut from the steel springs and trimmed to ¼-in. width. As the springs are to be depressed by the bucket cams, a small semicircular rub bar should be soldered to the top of each, 1⅜ in. from the contact point center, and for this purpose a short length of sixpenny nail, filed flat on one side, is satisfactory.

The thin brass plates bearing the other points are now pried from their mounts and screwed to the angle iron. They must be insulated, which requires some care, by using a thin strip of fiber or hard cardboard between a brass plate and the iron, and between the iron and the nut washers. The screws are insulated by winding strips of paper around them to form bushings, before putting them through the fiber pieces and the holes in the iron. Be sure to test each for a ground as soon as the screws are tightened.

THE bucket bearings are made out of the remaining contact mounts, and bent as shown before being bolted to the frame. Cut off the excess material above.

The trunnion pins are made much smaller than the bearing holes, so that there will be little friction due to corrosion or dirt. Grip a length of ⅜-in. machine screw in the chuck of a drill or lathe, and file down the pin to a diameter of 1/16 in. as it rotates. Insert it in a bearing hole and secure it with a nut each side.

The bucket can be mounted at this stage, and tested by tilting with the fingers. Sidewise play is regulated by running the pivot pins in or out. The cams should center on the contact springs and their rub lugs.

One or the other end of the bucket is always down. To limit the tilt, bend a yoke of strip brass to bolt on the end of one trunnion pin, securing it with a nut. In each loop put a piece of ⅛-in. machine screw with a nut below and above, for vertical adjustment, and solder a couple of brass angles to the bucket sides to stop against them.

The recording drum is of the type used on the seismograph described in a previous issue (P. S. M., Nov. '35, p. 66). For the shaft, use a piece of ⅜-in. brass tubing, allowing it to project a little beyond one end of the can, which is soldered to it. The other end is a threaded rod about 3/16 in. in diameter, such as a curtain rod. Wrap twine around the end to build it up to the diameter of the inside of the tube, and solder it.

Solder to the end of the tube a washer with a ⅛-in. square hole, and thrust into it a 7-in. length of square rod, which is attached to the hour-hand shaft of a clock with a small universal joint of the type used on radio condensers. This serves to turn the drum once every hour, while the threads move it lengthwise of the shaft 1/28 in. every revolution, making a pencil track that continues for about 5½ days. A coarser thread would separate the hour marks a little more, but reduce the number of days the paper would last.

THE recording pencil is held in a brass tube soldered on the end of a piece of spring brass, which in turn is soldered to an arm made of curtain rod and pivoted horizontally with a ⅛-in. pin. At the end of the arm is a brass bracket which carries a solenoid designed to draw the pencil spring sidewise when the bucket tips.

Make a solenoid bobbin by soldering a washer to each end of a piece of ¼-in. brass tubing, with a cardboard insulating washer inside each washer. Wind two thicknesses of friction tape over the tube, and solder a short length from the head end of a large nail in one end. Wind eight layers of enameled magnet wire, about *(Continued on page 105)*

MAKING A RAIN GAUGE

(Continued from page 104)

No. 26 gauge, around the bobbin, tape it well, and solder around it a jacket of soft sheet iron. Solder the jacket to the bracket when mounting the solenoid.

The plunger should be about 1/16 in. less in diameter than the bore of the solenoid (a piece of nail will do), and of such length that it will strike the core when the pencil has been drawn lengthwise less than 1/16 in. Insert it in the solenoid and try for clearance when soldering the pencil arm in place.

MOUNT the pencil assembly in a U-bearing on top of the support, and solder on a brass strip from which to hang the counterweight. Tie on enough nuts to ease the pencil pressure until only a thin, fine line is made.

The easiest way to attach the paper to the drum is to tack two corners with paste, wrap the strip around, and paste the other two corners. In order to have a starting point from which to space around to compute minutes, mark the pencil position at, say, 12 o'clock noon when the sheet is starting, and again near the end of the record. A straight line through these points then locates the beginning (or ending) of the hours.

To wire the gauge, solder a wire jumper from across both insulated bucket contact points, leaving it slack with the loop standing upright, where it will not be wet by water dumped from the bucket. Bring a wire from this through a hole punched in the reservoir near the top, properly bushed with a rubber sleeve, and connect it with one post of a bell transformer. From the other terminal of the transformer bring a wire to one lead of the solenoid. The other lead may be grounded to earth, while a wire soldered to the brass crosspiece of the bucket frame and brought through a hole in the reservoir side is similarly grounded. It is probably better, however, to eliminate grounds in favor of a complete wire circuit.

THE bucket assembly is placed on the reservoir top, the measuring tube being removed. Leaving off the center section, place the receiver and make a test. Put a measured amount of water in the tube and pour it slowly into the receiver. The bucket will tilt, and the solenoid will buzz, moving the pencil sidewise. Count these buzzes. Probably the bucket will tilt many more times than the number of 0.01 in. of water poured in. In this case weight the top of the bucket partition with brass clips, and adjust the stops to allow the bucket to tip farther. It may also be necessary to bend the contact springs upward so as to bear more heavily against the trunnions. A few trials will bring the bucket to approximately correct tipping frequency, when the clips may be replaced by a single folded brass sheet. A few more adjustments will make the register correct.

The tests should be made also with one contact disconnected, until the other makes contact every time. Then disconnect it and connect the first, making certain that it, too, contacts every time. Finally connect both again, and failure of record, due to missing contacts, will be almost impossible.

The bucket, pivots, and stop pins should be kept clean at all times.

Install the gauge at any suitable point, and put the recorder indoors.

HOW TO LUBRICATE CONDUITS

IT IS better to blow soapstone or a similar lubricant into a horizontal conduit before the wire is pulled. Where only the wires are lubricated, friction wears off the powder as the wire progresses into the conduit. On combination horizontal and vertical conduit runs with an elbow at the change of direction, pouring soapstone into the elbow from the top of the vertical run also is effective.—ARTHUR B. WEEKS.

MARIONETTE STAGE SETS

(Continued from page 71)

and the ferrule is struck against the palm of the other hand, thus flinging the paint from the brush over the body color. Sky effects are obtained in this way. Another method is to soak a sponge in color, wring it out, and pat it over the body color. The application of color with a commercial sprayer also has its uses.

COLORS may be toned down by using black, gray, or white with them. Adding black gives a shade of a color; adding white, a tint. Combining one color with a small quantity of another color makes a hue. We speak of an orange hue of red or a greenish hue of blue. Harmony of values can be obtained by using a variety of tints and shades of one color or several hues of different colors arranged at a fixed level. Stage sets and properties are usually better if painted under the lighting conditions in which they will be seen.

For the back drop, walls, and wings, you may use heavy paper, fiber wall board, or canvas or muslin stiffened by a thin coat of size. Even better than these is an insulating composition board with a surface like rough canvas. It does not warp noticeably and is so light that a picture wire stretched from side to side of the stage will support it. Its surface is such that the farther away one is, the greater the apparent depth of the scene painted on it.

Measure the height and width of the back drop and wing frames of your stage. With charcoal lightly sketch the design on wrapping paper. Step back about ten feet to see if the general arrangement, perspective, and proportions are correct. Make corrections, lay the sketch flat on a table, and complete it.

With white chalk or charcoal draw the ground plan on the stage floor—towers, walls, and the like. Perspective is obtained by differences in size and color value.

When this preliminary planning has been done, you can go to work making and painting the scenery as suggested in the accompanying drawings.

If muslin is to be used for the back drop, thumb tack a piece the size of the back stage on the wall or a drawing board, transfer the design you have prepared, and color it with crayons. When finished, spread newspapers on the floor or a table, place the muslin face down, and pass a hot iron lightly over it without pressing heavily. This will be found easier, as a rule, than sizing the muslin and painting the scene with tempera colors, but either method may be used.

TWO strips of wood (thin battens) are fastened together with screws along the bottom of the back drop, with the muslin between them. For the top make a hem, run a curtain spring through, and fasten each end to hooks or nails at the side of the stage. Tie a few inches of cord at each end of the spring and make loops to be slipped over the hooks

If the crayon decoration is too faint and delicate for your purpose, try decorating the muslin with oil colors diluted with gasoline. House paint will do. Commence with the lightest tint and work up to the darkest shades. Test the colors on extra pieces of muslin kept for the purpose. This paint will not crack, and no size is necessary.

Leg drops, which are single side drops (Fig. 4) and valances may be used with the back drops. A ground row (Fig. 1) is a set piece of wall board or cardboard resting on the stage floor between the acting zone and the back drop. It is often seen as a hedge or as a row of distant hills. Profile flats (Fig. 2) are screens with irregular tops and sides, made by forming a rectangular screen and then cutting the shape out of *(Continued on page 107)*

MARIONETTE STAGE SETS

(Continued from page 106)

cardboard and attaching it. Formal trees (Fig. 3) can be made by cutting the silhouette in cardboard, adding paper or felt leaves, and painting all green. A decorative tree may have silver leaves and golden fruit.

Scenery is of three kinds: 1. Hanging scenery, including draperies, leg pieces, cycs., drops, borders, and ceilings. The last are not often used in puppet theatres because they interfere with strings. 2. Scenery to bear weight. Except for occasional two- or three-step stairs (Fig. 5), scenery to bear weight is seldom used. 3. Standing scenery. About half of all scenery now stands on its own feet, and most of this consists of flats, the elements used for walls. One frame is a flat; two frames lashed together makes what is called a "book" (Fig. 6).

The scale of everything on the stage should be a bit enlarged rather than diminished.

A setting with a picturesque picket fence and a gate that can be opened by the puppets

Draped-curtain settings have great artistic possibilities; they can suggest columns, trees, and other things. For foreground trees, the material must be twisted in order to suggest the main tree trunks, and garlands of twisted material used to indicate the slender branches. The foliage consists of several layers of curtains with the edges cut out in layers and scallops.

Structural sets of blocks, cylinders, cones, and "books" give a very modern effect (Figs. 7, 8, and 9).

Columns and towers are easily made by rolling a form from stiff paper and pasting gray, white, or cream-colored paper around them. Brownish paper towels are fine for this. It is sometimes necessary to weight the forms with sand.

Sheets of green blotting paper are admirable for lawns. It need not be new; the ink lines and spots, with a few lines in crayon added, improve the effect.

The castle scene (Fig. 10) is made entirely of corrugated board cartons, with oatmeal boxes for the towers (Fig. 11). (The corrugated side of single-surfaced corrugated board makes good roofs, and log cabins for small stages can be made of it.) The castle and walls are given a coat of grayish brown tempera color and, when dry, touched up with accents of dark colors to suggest blocks of stone, and with green for vines and bushes at the base. A mountain may be cut out of cardboard and pinned to the sky drop, if desired

Squared paper will be found helpful in making your rough sketches. By dividing into squares a picture to be copied, one can easily repeat it on squared paper, enlarging it to any degree necessary, even though one is not an artist. (Continued on page 108)

MARIONETTE STAGE SETS

(Continued from page 107)

It is easy to see just what part and which lines go into each square. Divide the space on the paper into the same number of squares as those drawn on the original. They may be twice, three times, or four times as large, according to one's requirements. Number each square, both on the picture itself and on the paper. Beginning at the upper left-hand square, number them across; then start drawing on the same square of the copy and repeat from square to square.

IT MAY happen that the picture one wishes to copy cannot be marred by pencil lines, in which case square off a piece of tracing paper and attach it firmly over the picture. Another method which does not damage the original illustration is to use a pantograph, if available.

A garden scene is useful in ever so many plays. Make two sides of a house by bending a piece of corrugated board, mark a door and some windows, and, if desired, add a little porch with rose vines and a bench near by. This house is to be placed at left side of stage. With a sharp knife score the sides of the windows and cut through the top and bottom line, also on a vertical line drawn in the middle. By folding these parts back against the wall part, you will have solid shutters. These will look well painted apple green. Paste strips of paper on the back of the opening to imitate the small panes. Light showing through at night then gives a realistic effect. If the door is cut around top, one side, and bottom and scored on the other side, it will open and shut. This, too, may be painted green with black handle and hinges. The walls you can color as you prefer.

A garden usually needs a wall, and this may also be made of the corrugated board. Do not have it too high as it is better to have a pretty landscape on your back drop that may be seen above the wall. A large tree in back with limbs overhanging, and some bushes and smaller trees in the foreground, are desirable. Natural vines can be trailed over the wall the day you give your play. Branches from natural bushes make fine trees. An opening in the wall gives variety and affords an excuse for a pretty gateway.

TREES may be made from bits of untwisted rope for trunks, with the strands divided at the top to make the branches. A sand effect for stone castle walls and roads is obtained by covering the parts with thin liquid glue and, before it dries, sifting sand thickly over it, later shaking off the excess.

For rocks, crumple some gray or tan color paper and then pull it slightly apart till you have a mass such as you wish, and sand it as just suggested. A few lines with crayon may improve it. Colored wrapping papers may be used in various ways, so salvage every variety you get.

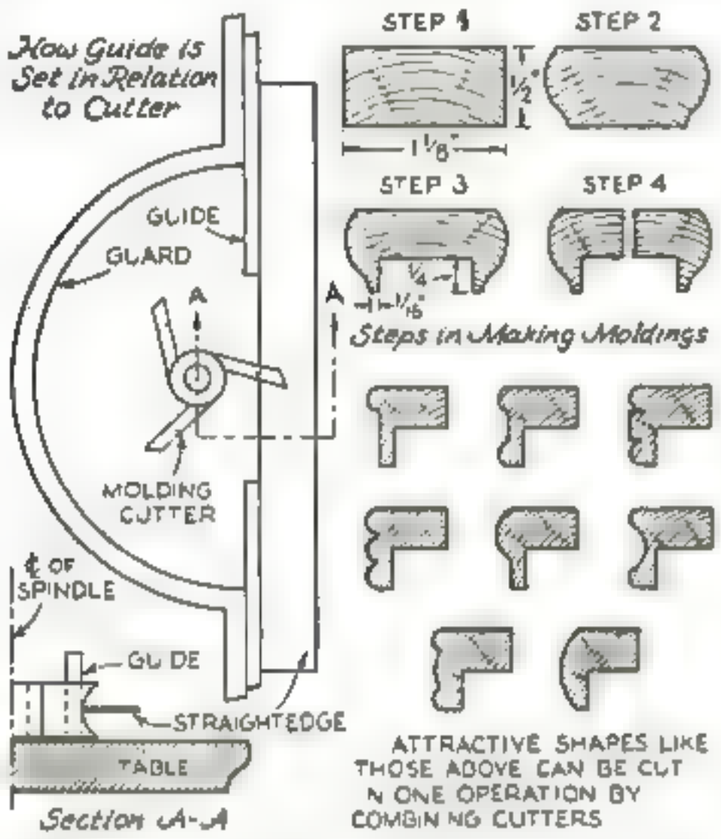
One of the photographs on the opening page of this article shows a fairy back drop with the parts cut out of wrapping paper colored in rainbow hues and then applied by sewing with long basting stitches to blue tarlatan (transparent muslin or net), which forms the face of the drop. It is touched up with lines and dots of silver paint. Light shining back of the trees and mountains and through the cut-out windows gives a delightful effect. A ground row is placed a few inches in front of the drop, back of which puppets may be made to walk.

Those drawings not heretofore referred to are self-explanatory. Figure 12 is a window grating of heavy black thread held with gummed paper; Fig. 13, a window in a stone wall; Fig. 14, a lattice window pane; Fig. 15, a fireplace; Fig. 16, a Dutch door in two parts with a workable latch and string; and Fig. 17, a blue cyclorama.

SHAPING PICTURE-FRAME MOLDINGS FROM SCRAPS

(Continued from page 74)

pieces of the molding to the proper length—in this case two 8-in. and two 10-in. pieces. The set-up illustrated in one of the photographs will enable you to make accurately fitting joints. Two pieces of wood, about 2 or 3 in. shorter in length than the smallest dimension of the frame, are nailed to the workbench at right angles to each other. Apply glue to each of the edges of the molding to be joined, and clamp them tightly on this jig with the rabbet of each strip fitting snugly against the jig. The strip through which the nail will go should be slightly up on the other so that when the nail is driven home, it will slide down to make a snug joint. Fasten all four corners, wipe off any excess glue with a damp cloth, and set



Method of setting shaper guide, the stock after each operation, and various moldings

aside to dry overnight. When dry, stain the molding and rub on two coats of furniture wax.

Most pictures, especially of scenery, are more attractive if mounted with a wide border around them. It also adds to their appearance if the mount has been plate sunk. To do this, cut a piece of cardboard the same thickness as the mount, about ⅜ in. larger all around than the picture itself. Center this on the mount and turn both face down on a smooth surface. With the handle of a spoon or toothbrush, press firmly on the back of the mount and run around the card which is underneath.

Cut to size and clean a piece of glass. Put it and the picture in the frame with a piece of corrugated cardboard in back, and hold tightly in place with small brads driven into the inside edge of the frame. Apply some rather thick glue evenly around the back of the molding and, when tacky, lay a piece of brown wrapping paper larger than the frame on it and rub into contact with the fingers. When the glue is dry, use an old razor blade to trim off the excess paper. This keeps dust from inside the frame. If this paper backing does not fit smoothly, rub a slightly moistened cloth over the whole area; as the paper dries, the evenness will disappear. Two small screw eyes and picture wire complete the frame.

DRILLING CONCRETE RAPIDLY

WHEN drilling concrete by hand, try holding the drill ½ in. or more from the bottom of the hole at the moment each blow is struck with the hammer. You will find that the plunger effect automatically removes much of the dust from the hole and saves time because it will not be necessary to stop to clean the hole by any of the various methods in common use.—CARSON LINEBAUGH.

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HOME WORKSHOP CLUBS REPORT PROGRESS

(Continued from page 76)

Brunswick (Me.) Homeworkshop Club. A metal spinning demonstration was given at a recent meeting in the Science Building, Bowdoin College.

Capital Homecraft Club, Washington, D. C. Lewis E. Johnson has been elected president, and Edwin S. Houck, treasurer. Ellsworth D. Jones continues as secretary. The new president has been especially active in obtaining members for the club. Mr. Houck makes a hobby of repairing and refinishing furniture, in which he is aided by the fact that a good deal of colonial furniture is to be found in Alexandria, Va., where he lives. Instead of purchasing lumber in board form, he finds it advantageous to buy old walnut bedsteads, which are made of a fine quality of wood, well seasoned through years of use . . . David and Jack Porterfield have completed three costumers which consist of a tapered square upright supported at the bottom by four dogs standing on their hind legs. At the top is a cat upon which a coat or cap may be hung. They have also made a folding tea table in maple, the legs being cut on the scroll saw and then shaped in the drill press. At a recent meeting in the Porterfields' shop, David Porterfield showed members some tools his father used in a carriage factory forty years ago. These included a spiral screw driver of unusual design.

Shenango Valley Homeworkshop Club, Sharon, Pa. With a membership of 50, the club made 250 toys and donated them to the Sunshine Society for distribution in Christmas baskets for underprivileged families. . . . The club's second annual exhibition will be held in the early spring. . . Roy Marx, a member, was the state and regional winner of the last Fisher Body Craftsman Guild competition in the traveling coach class. He has been spreading the home workshop hobby idea by appearing before the service clubs of Sharon and Farrell in company with William R. Pool, the club secretary. . . . A visit is being planned to a plant in Grove City where beautiful hand-worked aluminum ware is made.

East Side Sawdust Eaters Homecraft Club, Detroit, Mich. Plans are being made to hold a spring exhibition. . . . Demonstrations of four different makes of home workshop machines were given at a recent meeting in the basement shop of C. F. Vines, who is the club's secretary.

Great Falls (Mont.) Homeworkshop Club. Roy Horton has been elected president for 1936; Jack Creek, vice president; E. S. Epley, secretary; E. W. Luther, treasurer; and J. C. Dow, Dr. F. P. Silvernale, and C. A. Shelton, members of the board of governors. After the annual meeting, the members had a "Dutch" lunch. . . . A six months' program of talks and demonstrations has just been completed. The following topics were covered: woods, finishing, inlays and intarsia, use and care of small motors, metal spinning, craftwork with the new plastics, and the operation of a metal-turning lathe. A new program committee is to be appointed to arrange for another series of demonstrations. . . . An effort is being made to have the local fair board include awards for home workshop activities in the 1936 premium list. The North Montana Fair, held in Great Falls, is one of the outstanding shows of the Northwest, the attendance for six days usually running to about 150,000 paid admissions. . . . Past president Fred Cook has returned to Billings to make his home. He was a member of the Billings club before he came to Great Falls.

Homecraft Club of Pittsburgh, Pa. At a meeting held in a Pittsburgh hotel, with 106 present, an instructive talk on the manufacture and use of drills, taps, cutters, and reamers was given by (Continued on page 111)

HOME WORKSHOP CLUBS

(Continued from page 110)

A. J. Snyder, research engineer of one of the leading twist drill manufacturers. He covered the subject from the standpoint of both the machinist and the home woodworker. A buffet luncheon followed. The two door prizes were an indexed wire drill set of sixty-five sizes from No. 60 to 3/8-in., and a stand of sixty drills.

Cheyenne (Wyo.) Homeworkshop Club. The following officers have been elected for 1936: D. R. Kinports, president; C. H. Baker, vice president, and E. L. Kopp, Jr., secretary-treasurer. . . . Marvin A. Powell, who made the survey of the National Homeworkshop Guild which was summarized in a recent issue (P.S.M., Feb. '36, p. 60) is chairman of the board of directors. He is the mechanical arts instructor in the Cheyenne Junior High School. W. C. Schlosser, another member of the board, is also a manual training instructor in the same school, and Wayne Adam is an instructor in the Senior High School

Topeka (Kans.) Homeworkshop Club. The club meets regularly at the Central Y. M. C. A. building. . . . Clyde F. Cook, former president, who has moved to Wellington, Kans., was given a farewell luncheon and thanked for his untiring efforts to put the club in the outstanding position it now holds among home workshop organizations.

Spokane (Wash.) Homecrafters. An exhibition of craftwork, a demonstration on home workshop machines, and an address by H. C. Whitehouse, an architect, were given as a feature program before 175 members of the Rotary Club. . . . W. R. Green has been elected president for 1936; C. W. Charleton, vice president, and Fred C. Hughes, secretary-treasurer.

Fargo (N. D.) Homecraft Guild. More than eighty percent of the membership turned out for one meeting this winter when the thermometer stood at twenty-six degrees below zero. Paul Van Rohl gave a demonstration on veneering and described methods used in a Fargo piano company.

Edison Homeworkshop Club, Chicago, Ill. A spring craftsmanship contest is to be held with prizes to be awarded on the following basis: Workmanship, 40 percent; ingenuity of design and assembly, 25; finish, 25; and serviceability, 10. The judges, who will be chosen from outside the club membership, will also take into consideration whether power tools, hand tools, or both were used in making each project.

SEND FOR INFORMATION ON STARTING A CLUB

WHY not have the honor of organizing a home workshop club in your own community, if one is not already in existence? It is very easy to do as has been so clearly shown by the success of the many clubs already organized.

The best method of starting a club is outlined step by step in a free bulletin you can have by filling out the coupon below. Send for it at once.

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353 Fourth Avenue, New York, N. Y.

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Name .....

Address .....

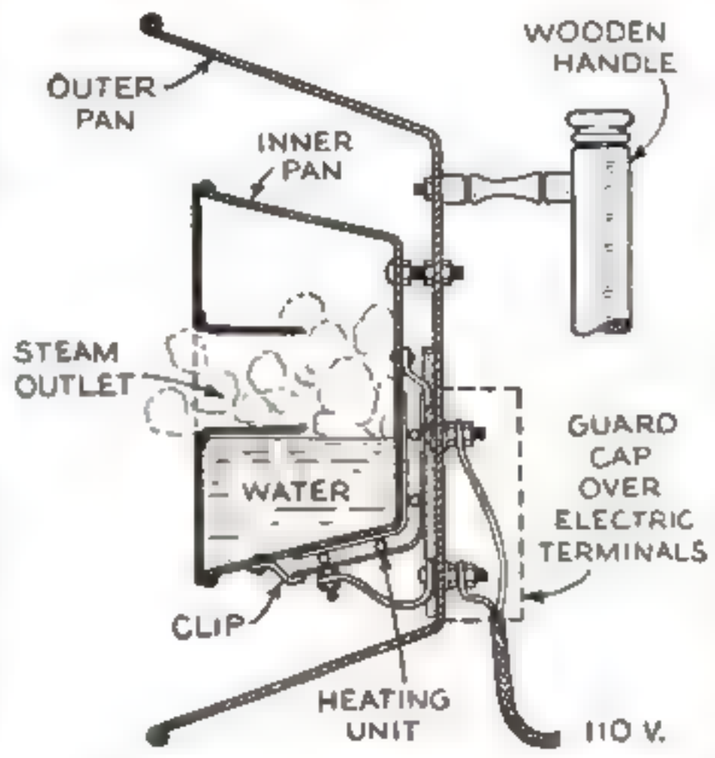
City ..... State .....

(Please print very clearly)

WALL-PAPER REMOVER BUILT FOR DOLLAR

(Continued from page 59)

there is as much space as possible between its outer surface and the plane of the large pan edges. It is a good idea to place a layer of asbestos between the two pans, to act as a heat insulator. One of the heater-unit terminals projects through the back of the large pan, being insulated from it with mica. The other terminal is connected by means of a short piece of



Cross Section of Wall-Paper Remover

How the inner pan with heating unit attached is assembled within the larger and deeper pan

wire with a second bolt an inch or so from the first, and similarly insulated. Fasten the heavy-duty, flexible power-cord wires to the two bolts, and solder over them an arched piece of tin plate to prevent accidentally touching the live parts. A wooden coffeepot handle or some similar means of holding the remover, bolted to the back of the outer pan, completes the device.

When you are ready to use the wall-paper remover, fill the steam-generating chamber with enough warm water to reach almost to the end of the tube that projects inward from the steam outlet hole or holes. The chamber illustrated holds 8 oz. of water. Set the remover on edge, with the heating coils down,

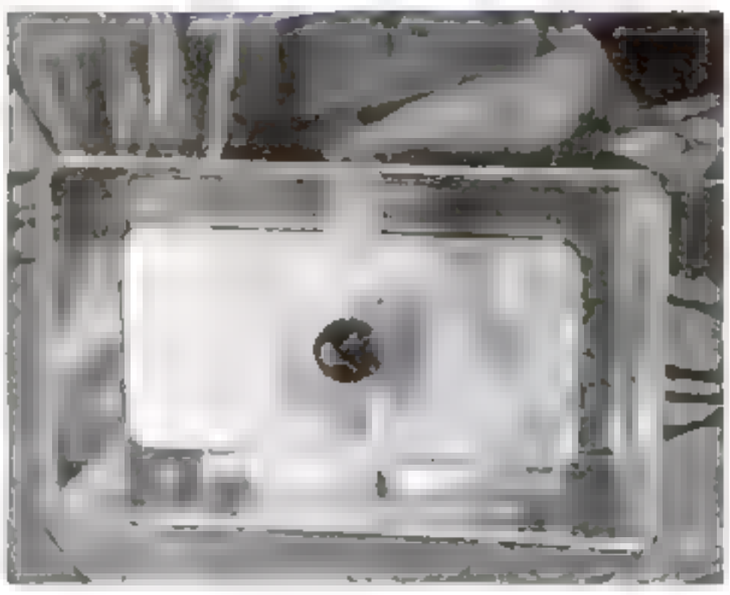
Soldering tube to cover of inner pan. Two or three smaller tubes would be even better

and turn on the current. Steam will begin to emerge in less than two minutes.

To remove the paper, hold the device against it until the steam has had time to loosen the paste, a matter of a few seconds. Then, by moving the steamer slowly down the wall, the paper can be peeled off cleanly in long strips. Watch the water *(Continued on page 113)*

WALL-PAPER REMOVER BUILT FOR DOLLAR

(Continued from page 112)



The working side of the remover. Note the sheet-metal strip used to brace the inner pan

level, which you can do by looking into the steam hole or holes, and refill before all of the water has evaporated, otherwise you might damage the remover by melting some of the solder.

It is a good idea to wear a heavy leather glove on the hand used to hold the device, for it gets fairly warm with prolonged use. This steamer can be used on either side walls or ceilings.

MODERN NAME PLATES

(Continued from page 73)

from the nearest edge of the cast-resin sheet.

Jig-saw work with cast resins is similar to that with plywood, although there are a few minor exceptions. Chief among these is a difference in speed. It is advisable to push the work more slowly against the saw and to move back more frequently to permit the blade to clear away any dust that may gather. Particularly if a light-colored resin is being used, care should be taken to avoid scorching the material by forcing it too fast against the blade

While the ideal in cutting is to follow the line exactly, it is obviously better to err, if at all, by cutting on the outside. Any excess can be taken off when the letters are trued up and finished with a file. This caution applies particularly to sharp corners. Instead of trying to force the blade to turn a right angle, it is best to withdraw the work a trifle and widen up the cut so that the blade can turn easily and start the new line. Some slightly rough spots will be left, but these can be easily cleaned up by filing. If a hand scroll saw is used, care must be taken that the stroke is always vertical to the surface of the letters.

When the letters have been cut, their edges should be trued up and all saw marks removed. This can be done with a file, either by hand or with a file used in the motor-driven jig saw. Outside edges can often be finished more quickly with a revolving sanding disk. In this case, have the table or horizontal guide block set at right angles to the sanding surface so that all edges will remain vertical.

The process of polishing will vary with the size of the letters. If these are less than 1½ in. high, it is best to polish the flat sheet from which the letters are to be cut, before pasting the guide letters on the panel. In this event, polish only the front surface.

On small letters, careful filing will provide a sufficiently neat appearance for the edges of the letter, particularly if the thickness of the material is not in excess of ¼ in. On large letters, polishing may be done after the cutting and filing are completed, and the edges may then be polished as well as the front face. In no case waste any time in polishing the back faces of the letters, as a rough surface will adhere much better (Continued on page 114)

MODERN NAME PLATES

(Continued from page 113)

when cemented to the back plate.

The polishing itself is carried on in two steps. The rough polishing is done with a muslin-disk wheel and powdered pumice mixed with water. The final polishing requires a similar muslin-disk wheel and either a special polishing compound supplied by cast-resin makers or carnauba wax or any clear, powdered floor wax. Follow with a final buffing on a clean, dry wheel.

The letters are now ready for cementing to the back panel, which should be cut to final size. Use a hack saw, band saw, or circular saw to cut the panel unless it is irregular in shape, in which case a jig-saw or band saw is required. The panel should then be polished on its front face and edges and, if it is to hang free, on its back as well. If used with a light box, the back face should be left unpolished, or even sanded with a fine grade of sandpaper, as the rough, frosted surface will break up the light rays and prevent a spotty lighting effect. This sanding is done with a circular motion, and the finer it is, the better.

HAVING finished the back plate, mix a small amount of cast-resin cement in a small open glass dish. This cement consists of liquid resin, which is caused to harden by the addition of a few drops of hydrochloric acid—6 parts to 100 parts of cement—and thus provides a firm bond that is as strong as the cast resin itself. Because of the hardening action, it is essential that the cement be used within a few minutes of mixing and that only small batches be mixed at a time. When a great deal of work is to be done, the hardening may be slowed up by mixing a few drops of alcohol with the resin cement before adding the hydrochloric acid. This, however, will increase the time required for the work to set.

Apply the cement with a metal or hardwood spatula to each letter in turn, covering the surface sufficiently but without any excess that will ooze out. Then place and true up the letter before going on to the next. No pressure is necessary beyond that of the hand at the moment of applying. When all the letters are in place, cover the work with a layer of tissue paper and set the entire sign in a horizontal position on wood blocks over a radiator for from two to five hours.

Upon removing the sign, scrape away any excess of resin that may have oozed out beyond the letters. Drill and countersink corner holes if the sign is to be attached to a wall, and prepare small round disks of cast resin, either of the same or a contrasting color, to be cemented in the holes to conceal the screw heads. Use long flathead wood screws. If the sign is to be attached to concrete, brick, or tile, drill holes and insert suitable fiber plugs, or glue and wedge wooden dowels into the holes before driving the screws. The insertion and cementing of cast-resin disks flush with the surface of the sign over the screw heads will render the sign practically theftproof.

Periods and other small parts such as apostrophes, which are too small to jig-saw, can be inserted by drilling or carving the back plate and filling the depression with colored lacquer to match the lettering.

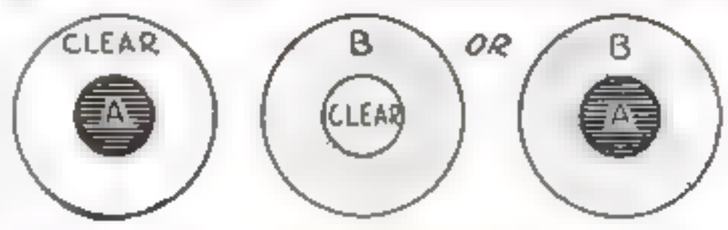
This is the sixth of a series of articles on using modern plastics in the home workshop. The first article appeared in the November, 1935, issue.

RUBBER HOSE OF SPECIAL SIZE MADE FROM OLD INNER TUBE

WHEN a short length of rubber tubing or small diameter hose of a certain special size is not available, a substitute can be made by wrapping a strip of inner tube around a wood dowel of the required diameter. Use a wide lap joint and fasten it securely with rubber cement.—K. L. R.

RAINBOW TINTS ADD POWER TO MICROSCOPE

(Continued from page 45)



Two knife-edge rings fashioned on a piece of shafting makes a tool for cutting out perforated filter disks and center inserts, as shown

and spherical aberration, are caused by the action of different wave lengths (different colors) of light passing through the lens.

The best lenses, which are corrected for several colors, are priced so high as to be out of reach of the average amateur. While the better makes of low-priced instruments have lenses that, for the money, are excellent, many of the cheaper ones seem incapable of focusing any color at all. Much of the trouble comes from the fact that the lens system brings each color of light to focus on a different plane, the combined result being a blurred visual image

Fortunately, even the poorest lens usually can be improved by screening out some of the colors, and examining the object by the wave lengths of light that can be brought to a focus at one point. This is easily accomplished by use of color filters, although, with stained or otherwise colored specimens, the use of a filter for improving the lens performance may destroy the advantages of color in the specimen.

Perhaps the best color to use for making cheap lenses behave like costlier ones is green or greenish yellow. Sometimes a blue-green color will prove best. The best method is to try various colors until the most satisfactory one is found. The main idea is to use a filter that confines the light beam to a narrow band of the visible spectrum. Sometimes a combination of two filters will do the trick, such as the Wratten G and H filters, which transmit a pure green. Unless the filter is very light in color, it is advisable to use more light, to overcome the loss of intensity resulting from absorption of some of the colors.

FOR observing very fine details, the use of a blue-green filter is desirable because this increases the resolving power of the microscope. Since resolving power depends on the wave length of the light used, being greater with shorter wave lengths, the elimination of the long-wave red light is desirable.

Anything that is transparent and colored can be tried as a filter. The best way of judging its success is simply to see how well it works. If you live in a city where there is a theater-supply house, you may be able to obtain little sample filter books. These contain many small sheets of transparent gelatin of various colors. You can use these sheets as test filters, although they may be a little small for some purposes. Larger sheets can be purchased for a few cents each. One such piece will make enough filters for a dozen microscopists, with enough left over for a set of color-differentiation filters, which will be described

You can purchase colored glass in sheet form and cut to whatever size you want for use as filter ma- *(Continued on page 116)*

RAINBOW TINTS ADD POWER TO MICROSCOPE

(Continued from page 115)

terial. The "five-and-ten" may yield useful filters in the form of colored celluloid or cellulose film.

If you want something scientifically correct—something concerning which accurate information is available as to wave length of the light transmitted and absorbed—you can get one or more Wratten filters. These are obtainable in the form of gelatin sheets costing a few cents per square inch, or as gelatin cemented between optically flat glass plates. Glass-mounted filters are made in sizes that will slip into the filter ring mounted below the condensers of high-grade microscopes. The filter best adapted for any given purpose can be determined by consulting the manufacturer's charts.

If you employ colored gelatin for microscope filters, it will be necessary to mount the sheets between glass, to preserve them. The gelatin sold for use over theatrical and store-window lights is fairly durable, but all that the writer has seen is affected by water. The Wratten filters in sheet form are damaged by touching with the fingers.

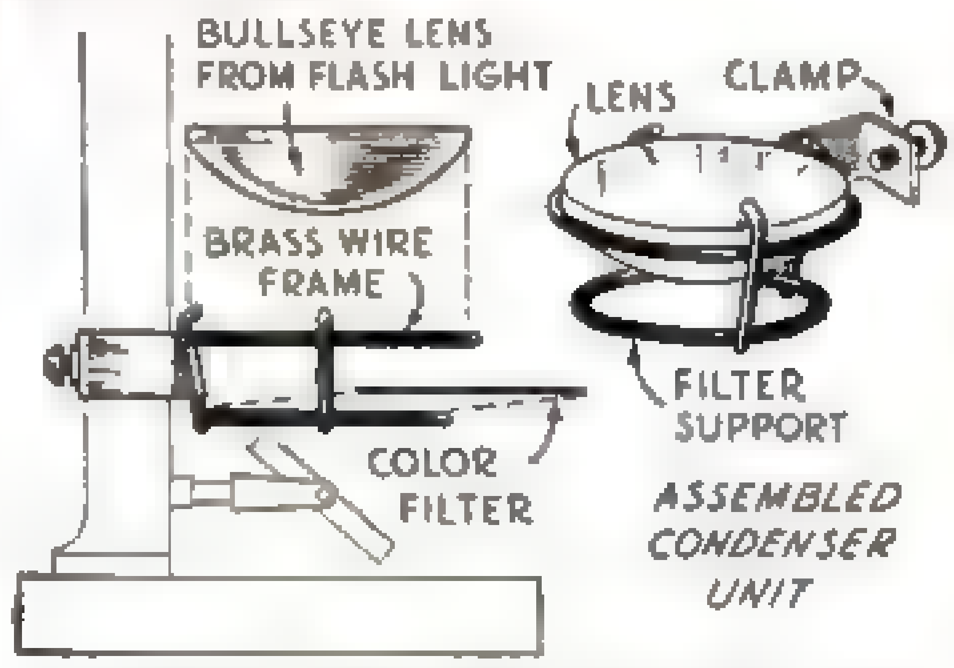


Diagram showing how flash-light lens held in frame of wire makes a microscope substage condenser. Color filter fits in lower wire ring

The microscopist who attempts to make successful photomicrographs will find it impossible to obtain good results without a set of filters. Among those he probably will use most are the Wratten A, B, C, E, F, G, and H, or their equivalents. The effects of these filters can be determined most easily, before making the exposure, by looking at the specimen while the filter is in place between microscope and light source. Many instruments not equipped with lenses corrected for photography perform best with green light as produced by using the G and H filters in combination, or with the green, B filter alone. Orthochromatic plates or films can be used for making photomicrographs by green, yellow, blue, and other light that contains no red. When red rays are involved, panchromatic negative materials are necessary; and these can be used also for all other colors.

If you have a microscope equipped with a substage condenser and a filter ring, you can experiment with differential-color illumination—and feast your eyes on some of the most beautiful sights to be found in the field of microscopy. If your microscope is not equipped with a substage condenser, you can rig up one, using a plane-convex or bullseye flash-light lens in the manner shown in the illustrations.

The substage condenser directs a cone-shaped beam of light upward towards the slide, bringing it to a focus in the plane of the object. Now, if you arrange things so that the center of the beam is of one color and the outer portion of another; and if the condenser is focused properly, a striking effect is seen. The object appears colored, against a background of another color. The color of the center of the beam determines the background color, and of the outer ring, the color of the object.

To make a set of color disks and rings similar to those em- *(Continued on page 117)*

RAINBOW TINTS ADD POWER TO MICROSCOPE

(Continued from page 116)

ployed in the Rheinberg system of differential-color illumination, you need only cut colored rings and mount them on suitable supports as described, or cement them between very thin sheets of glass or other transparent material; and colored disks or central stops, and mount them in the same way. The hole in the ring is the same diameter as the central stop. For a standard American microscope, make the ring thirty-three millimeters outside diameter, with a sixteen-millimeter hole; and the colored central disk sixteen millimeters. For homemade, bullseye condenser systems, different dimensions may be necessary, these being found by trial. Usually a smaller center disk is necessary.

Suitable colors for the rings include red, blue, yellow, orange, and green. For the central disks, red, blue, green, purple, and black.

THESE disks and rings are inserted into the microscope filter ring in pairs, to give various combinations of colors. Thus, with a red ring and a blue disk, the object will appear red against a blue background. Remove the disk but leave the red ring in place, and you will see a red object against a white background. Insert the black disk, and the object will be red against a black field. If you close down the iris diaphragm below the condenser, the object is seen in a color determined by the center disk.

In viewing diatoms, radiolarians, insect eggs, plant pollen, and a host of other objects, this system increases the beauty and helps bring out detail. In laboratories, differential illumination is used extensively in the examination of uncolored woven materials. The woof can be rendered in one color and the warp in another.

To accomplish this, a sector stop is used. This consists of a two-color ring stop with the colors arranged alternately in quarter (ninety-degree) segments. In making an observation, the disk is rotated until one color brings out the detail in one direction and the other emphasizes that in the transverse direction. By using a ring stop half (180 degrees) red and half blue, one side of the object will be illuminated with the red and the other with the blue light.

In cutting the disks and rings from colored gelatin, it is advisable to use a method that will produce clean, even edges. Careful work with fine shears will do the trick. One microscope enthusiast uses a set of leather punches, which he obtained from a hardware dealer. These punches are essentially ring-shaped hollow chisels which are struck with a hammer. One of them cuts the outer circumference of the ring, and the other punches out the center and at the same time forms a center disk. A piece of dense composition building board or a sheet of zinc can be used as a surface on which to cut.

IF YOU have a lathe, you can make a tool that will cut both ring and disk with one blow. On the end of a piece of shafting of suitable diameter, turn two knife-edged rings, of the correct diameters, and projecting at least one eighth of an inch. If you have many rings to make, it will pay you to have the cutting edges hardened. The overall length of the piece of shafting should be four or five inches. To cut unperforated disks for mounting the color rings and small disks, lay the material to be cut over a hole made in a piece of soft wood, this hole being slightly less in diameter than the outer cutting edge. The center cutter, having nothing against which to act, will not affect the material.

Ready-made Rheinberg color rings and disks, of colors selected with scientific accuracy, can be purchased from the same source as Wratten filters.

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Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 750 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

FOUNDATION FOR DOCTOR'S DEGREE

I taught school for two years at home before going to college and during this time I managed to finish a year's work toward my bachelor's degree in the Correspondence Study Department of the University of ———. This consisted of two courses in composition, three in economics, trigonometry, ethics, short story and German composition.

I am inclined to think that it requires an adventurous spirit to take trigonometry and German composition by correspondence, and ethics and economics are certainly not on the preferred list for college freshmen. Be that as it may, the work was very helpful and thoroughly enjoyable. Some time I should like to find the men who gave the second course I had in composition and the course in ethics, and tell them that their courses still stand out in my recollection as two of the most inspiring that I have ever had.

When I entered college, I found the work in residence very easy. After one has done a year's work without attending a class and has written out the whole of every assignment, the happy-go-lucky, somewhat desultory community effort in

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Secrets of Success

college class rooms is not likely to be burdensome. I found that correspondence study had developed in me an independent attitude toward study and had increased my ability to turn off an assignment on nearly anything with promptness and dispatch.

Another great advantage of correspondence work was the training it gave me in the independent use of books and libraries. I find that I am still more or less inclined to apply the correspondence study method and to feel that all is as it should be if I can only get the books that contain what I want to know.

Since taking this work by correspondence, circumstances have made it possible for me to take bachelor's, master's and doctor's degrees at a large university and to enjoy the privilege of spending a year since the doctorate as a research student at the University of ————. Of one thing I am sure, if I had to give up any part of my college training and could choose which part it would be, it would certainly not be that part I gained from correspondence study.

After obtaining my bachelor's degree, I taught in Saginaw, Port Huron and Detroit high schools and have been on the staff of ———— University, Detroit, ever since I received my doctor's degree in 1924.—*K. C., Detroit, Mich.*

GAVE HIM A NEW CONCEPTION OF LIFE

Usually when one thinks of a home study course it is in relation to money valuation or advancement along a line of promotion. I have felt that way myself and at one time began a home study course in mechanical drawing purely with bigger pay in mind.

Home study of any of the "job-getting" courses is well worth while. But eventually dull times come along and jobs disappear like June bugs at the approach of winter. The job-holder's tricks are then out of demand. He begins to realize that his preparation has merely placed him in a position of total dependency upon others for support.

The time when a man has no job is coincident with the time when he needs one most. It is a time that tests his metal. He asks himself what to do. A score of indefinite propositions loom up before him. In such a predicament what phase of home study would tend toward getting him on the way out of the dilemma? In my own case a high school course did it.

In 1911 I went to work as telegraph operator for the ———— Railway. I had only a grammar school education. I wanted to learn more and did read many books, but my reading was scattered. I got nowhere. I needed guidance; system. Yet I could not leave my job and go to school. I had a family to support.

In February 1921 I began a home study high school course with the ———— School of Chicago, and finished it in 1924. This course broadened my conception of life, not only in the industrial

Secrets of Success

world but also in the scientific and philosophic world. I got a taste of astronomy, chemistry, physics, botany, civics, history, and literature. The introduction to these subjects has led me on to a greater understanding and a deeper appreciation of our wonderful civilization. I know that health is more to be sought after than promotion; that happiness is of far greater value than stocks and bonds; that success is not a product of high-power salesmanship, or of engineering a big business, or of winning an election.

In my study of civics, history, and literature I have seen many a conflict in both war and peace. I have seen many depressions come and go, and still civilization has steadily marched on. I know enough not to allow dull times to make a pessimist of me for I have a fairly good understanding of what man has been in the past; what he thought, what he did, and how he suffered. I know what he is today. I see him tossed to and fro by the industrial tides and shattered by financial upheavals. I don't think I should have ever understood these conditions if I had not had the guidance in my study at home.

The modes and manners of life from the dawn of history are shown by the industry and handiwork of man. The pyramids of Egypt, the wonderful architecture of Greece and Rome, and the mounds of America are records of other ages. We need only to know of other ages to appreciate our own. We need an education sufficient to enable us to live and make use of the many opportunities that exist today. We need only to search the pages of a magazine like this to see what man is doing now.

Home study has revealed all this to me. It is beyond estimation in monetary terms. It has made me observant, tolerant, self-reliant, and happy.—*J. G. V., Somerset, Ky.*

CHANGE-MAKING COIN HOLDER DISPENSES WASHERS IN SHOP

IF MANY iron washers are used in a shop, it pays to get a change-making money holder of the type used by conductors and street venders. I bought a used one from a newsboy for twenty-five cents and found that the four coin chutes corresponded approximately to the four sizes of washers I used most often. On pressing the levers, the washers came out freely from all but one of the tubes, but I remedied this by inserting a screw driver in the bottom slot and carefully bending the brass downward. After loading the dispenser with washers, I tacked it in a convenient place on the wall back of my bench, and since then it has been a real timesaver.—WALLACE H. MCCLAY.

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POPULAR SCIENCE MONTHLY
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TOMBSTONES GIVE CLEWS TO EARTHQUAKE ZONES

(Continued from page 39)

quake' may have an epicenter miles from the epicenter of the major quake.

"Of course, the trigger quake leaves a photographic record on the sensitized tape of the seismograph. Instantly following the record of the small quake come the waves of the major quake. These are so violent that they often clog the machine, leaving only a confused jumble of lines which cannot be deciphered. The only clear mark on the tape is the record of the trigger quake. This record may be mistaken for that of the true epicenter of the major quake.

"In this way, the seismograph may place the epicenter of the major quake miles from its true location. In such cases, an excellent check is provided by calculations based on the fall of columns, such as tombstones."

In October, 1935, the destroyer which gives no warning struck again. Helena, Mont., was laid in ruins.

A complete survey of the region has not yet been completed, but preliminary observations tend to prove that fallen tombstones have again pointed out the epicenter of the quake.

Reports from seismograph stations have placed the center of the quake as much as seventy miles from the area of greatest damage, which lies within the city of Helena. Altogether, the evidence of the seismograph on the Montana quake has been rather confusing. No final conclusion has been reached up to the present time.

On the other hand, take the evidence of the tombstones:

In four cemeteries just outside Helena, the majority of the stones fell either toward the south or southwest. In one cemetery, located in the area of greatest destruction, the stones fell in every direction but north.

The falling of the stones in many directions usually indicates that they were directly over the epicenter. The fact that no stones fell towards the north may prove that the shock, instead of being a wave motion, was a general shifting of the earth from south to north. A majority of the lines of the direction of the fallen stones cross in the area of greatest damage

Fallen tombstones have brought us one step closer to conquering the destroyer which lies beneath our feet and brings sudden death. Death's own markers are betraying this dealer of death.

NEW RECIPES TO MAKE MEDICINE TASTE BETTER

MEDICINES that taste better are promised by the latest, revised edition of the National Formulary, a sort of official recipe book for pharmacists. The salty taste of bromides is now to be offset by sirup of raspberry, the recommended "vehicle" for such preparations. Sirup of acacia is another new "vehicle" for medicines of disagreeable taste; its effectiveness results from its colloidal action, which keeps the medicine from coming in contact with the organs of taste perception in the tongue. Sirup of cherry, a third addition to the Formulary, has a tart but pleasant flavor that serves as a mask for sour-tasting drugs.

SEEK USE FOR THICK OIL

CHEMISTS who recently succeeded in producing an oil so thick that it resembles taffy in consistency, and can hardly be poured from a bottle, are now wondering what to do with it. Because of its extreme viscosity, its use as a lubricant appears unlikely, and it may be applied to retard rather than to assist motion. The new oil is a petroleum product and can be manufactured in commercial quantities as soon as an application is found.

DEATH GETS RED LIGHT

(Continued from page 13)

zones are really danger zones unless there is some substantial protection against on-coming traffic. However, solid blocks of concrete are too great a menace to the automobiles, completely wrecking any car that crashes into them.

Engineers noticed that, after a snow, the wheel tracks of automobiles left a V-shaped unmarked area at each end of the safety zone. Any driver who entered this space was likely to run into the end of the island. So, in this unused area, the traffice experts constructed a flatiron-shaped buffer. If the car strikes it, it deflects the machine with the least possible damage. And, if the auto hits head-on, the front axle scrapes along the upward-slanting rib of the buffer and brings the car to a comparatively gentle stop.

IN CLEVELAND, OHIO, recently, such a buffer was installed in a busy section of town. Made of concrete and painted black and silver, it weighed 3,700 pounds. A powerful light shines down on it from above, making it easily seen for a considerable distance. Protective buffers of this type are suggested for all safety islands.

At crossings where automobiles travel in more than four lanes, there are to be "pedestrian refuge islands" in the center. And, no pedestrian is to be forced to dodge through more than three lines of autos going in the same direction. Even if there are signal lights, safety zones will be used at wide crossings to accommodate walkers caught in the middle of the highway by a change of lights.

Reflector buttons of various kinds play an important part in the standard signs proposed. All "Stop" and other important signs are to have the letters made visible at night by red reflectors, while the borders of the sign, revealing its shape, will be illuminated by colorless disks

To determine how much light various types of buttons will reflect, photometric tests have been carried out under the auspices of the Society of Automotive Engineers. In these researches, a beam of light was played upon the disks under trial. As they shifted from one angle to another, the sensitive light-measuring photometer recorded the amount of illumination reflected by each. It was such tests which led to the high-efficiency buttons specified for future signs.

Riding on the headlights of special cars, in another series of experiments, moving-picture cameras recorded how different kinds of lights illuminate the highway and where signs should be placed to be seen most easily. Thus, the specified placing of the signs—with their centers exactly three and a half feet above the crown of the road—is not a haphazard recommendation. It, like the other proposals, has its sound scientific basis.

LIKEWISE the placing of "Hill" signs. These are to be located according to uniform engineering formulas which distinguish harmless grades from actual hazards. The latter include: a down grade combined with a turn, a six-percent down grade more than 2,000 feet long, a fifteen percent down grade more than 200 feet long and any down grade having a drop of sixteen percent. As a result of this scientific approach to the problem, drivers who see a descent marked "Hill" can be sure it requires careful attention.

In most American communities, acceptance of these uniform traffic rules and devices will entail minor changes if not wide revision of present methods. Several years will probably pass before the standardization is complete. But the work of inventors, scientists, and laboratory men have blazed a path out of the confusion of today that leads toward the goal of highway safety.

STRANGE TESTS PROMISE NEW HIGH-SPEED TRAINS

(Continued from page 35)

an hour on the Claymont proving track. The results further confirmed the usefulness of the new test methods. No more side pressure was exerted on the rails by the GG-1, which proved the superior type, at a speed of ninety miles an hour, than earlier locomotives had shown at seventy miles an hour. Here was a clear gain in speed with no sacrifice in safety or increase in wear on rails and other equipment. Following the successful trials, fifty-seven more locomotives of this type were ordered and are now in service. The sleek, streamline 4,620-horsepower engines whisk the fastest of the New York–Washington passenger trains over the run in three and three-quarter hours, covering 225 miles in 225 minutes—a new achievement in speedy transportation on this route.

LARGE-SCALE tests of the kind made by the Pennsylvania Railroad were necessary because, until now, no satisfactory mathematical theory has been available for calculating in advance the behavior of a projected high-speed locomotive. Once this was developed, the design of a locomotive for virtually any speed might be worked out on paper, to order. Great research organizations have recently tackled the problem, and engineers of the General Electric Company and the Westinghouse Electric and Manufacturing Company report that they now have mastered its fundamentals. With the practical application of this knowledge, experts foresee changes that will have far-reaching effects on the travel habits of the next generation.

To check the theoretical work, Westinghouse engineers built a small locomotive model that contained, in simplified form, all the mechanical features necessary to produce "nosing." It ran on rollers instead of a track, to facilitate study of its sideward motions, which were photographed with a high-speed movie camera. At a speed corresponding to about ninety miles an hour for a full-sized locomotive, it traveled smoothly so long as it was not disturbed. A slight push of the finger, however, started it swaying violently from side to side, and the swaying continued indefinitely even though the model was not disturbed again. At lower speeds, it was observed, no swaying occurred.

From tests like these, designers are learning how to make the built-in speed limit of a locomotive higher than any speed it will be called upon to attain in service. How far can they go in increasing the pace of railroad trains?

STRIKING advances already made, in providing faster train service, show what engineers applying the new research methods will have to build upon. A trip between New York and Chicago now takes only sixteen and a half hours, following the fourth schedule cut since 1932, when the time for the 908-mile run was twenty hours. Streamline trains now make the 2,272-mile trip between Chicago and Portland, Ore., in less than forty hours, and may soon materially reduce the fifty-five hour running time of crack trains over the 2,228-mile distance between Chicago and Los Angeles, Calif. Next June will see the inauguration of the fastest long-distance passenger trains in the world, when Diesel-electric streamliners will travel between Chicago and Denver in sixteen hours, covering the 1,048 miles at an average speed, stops included, of more than sixty-five miles an hour.

Boosting the speed even of trains like these, however, is far from a remote prospect. Because Americans like to get wherever they are going in a hurry, the railroads would like to be able to do it, and the newest research points the way.

DARE-DEVIL BOY PILOT HAS THRILLING ESCAPES

(Continued from page 37)

As soon as his equipment arrived, Kurtz rolled his ship out of the hangar, and set to work tuning it for the most hazardous of all his flights, the race up Mexico and across a 500-mile stretch of the Gulf of Mexico to New Orleans and on to New York. At seven in the morning, after an all-night struggle to make ready, he took off. Weather: foggy. Ceiling: 200 feet. Winds ahead: unfavorable.

FIVE hours later, he reached Pt. Aransas, on the western shore of the Gulf, where he set his course for Pt. Tigre, 150 miles southwest of New Orleans and, according to his calculations, four hours and thirty-five minutes, across the muddy waters of the Gulf. Get the picture? A tired, hungry boy rocketing through the air without benefit of radio, hoping to make land before night. His only peace of mind lay in the knowledge that his engine never had failed him, that the patched inner tube, pumped up the night before, lay behind the main reserve gas tank in the forward cockpit.

On he flew, now barely skimming the waves, again climbing to 8,000 feet, ever seeking better winds. Frequently he checked his drift. A thirty-five-mile wind was blowing him away from the mainland. He shoved the left rudder forward, crabbing into the wind. An hour off Mexico the air, which had been bumpy, smoothed out, and he became very sleepy. Twice he dozed, only to find on awakening that he had climbed 1,000 feet. Once, low clouds obscured the horizon and he climbed to 9,000 feet, for safety lay in gaining altitude.

At sunset, with Pt. Tigre not yet in sight, Kurtz picked up a steamer in the distance. Checking the ship's course against the sun, he took a bearing on its wake, and headed toward New Orleans. Forty minutes later, he sighted land. Then darkness fell. For an hour he roared over the Southern Louisiana swamps. Whether his gas supply, much of which had been consumed in battling cross winds, would carry him through, he did not know. "I was afraid *Yankee Boy* and I would have to part company," he said. He throttled the motor back to conserve precious fuel, and, after a nerve-tingling flight over the swamps and marshes, was relieved to see the lights of New Orleans ten degrees off his nose to the right.

Kurtz thought his troubles had ended when he reached New Orleans. But he flew into Richmond, Va., in weather so thick he could not see from one light beacon to the next. He sat down at New York to find he had completed the flight in twenty-two hours and four minutes flying time.

And his big thrill was yet to come!

RECORD flights ended, the youthful champion turned west, headed across the continent for Southern California and home. He flew into Chanute field at Rantoul, Ill., in a driving rain. This entry in his log book two days later tells graphically of his troubles:

"Lines clogged by dirty gas picked up in Mexico and motor cut out on two successive take-offs . . . almost lost *Yankee Boy* . . . good thing Army fields are big . . . second time cut out just missed nosing up at end of rain-soaked field . . . everyone, including commanding officer, complimented me on set-ons . . . was just plain lucky . . . pulled tanks—and were they filthy! . . . weather very bad . . . Army pursuit ship cracked up trying to make here yesterday . . . I came in from north while he was flying in from south . . ."

On the third try, Kurtz roared off the field, again headed west. He refueled at Omaha, Neb., *(Continued on page 126)*

DARE-DEVIL BOY PILOT HAS THRILLING ESCAPES

(Continued from page 125)

again at Cheyenne, Wyo. "Weather O.K. except for a little wind," read the weather report. Twenty minutes after landing at Cheyenne, the flyer took to the air again, and within twenty minutes was literally blown into the earth by a seventy-mile gale.

Hardly had he cleared the airport and climbed 200 feet when *Yankee Boy* began to drop out from under him. A dozen times he climbed, the eddying wind drove him down, and only the ground cushion saved him. For thirty miles this war with the winds continued, when the gale cornered the young flyer at the base of a pass. Gradually his wheels came closer to the earth, and at last, unable to turn in the down draft, Kurtz throttled back and stalled the little ship into the hill.

AS HE idled the motor, the ship started to roll down the hill, tail first. Finally, realizing he could not race the motor all night to hold the plane, Kurtz killed the motor, leaped from the cockpit and, hanging desperately to a wing tip, turned the plane around. Working frantically, he lashed the tail wheel to his parachute. Throughout the night he battled the wind, hanging on first to one wing, then the other, hoping the gale would diminish and he could take off.

For two days, he sat on that bleak Wyoming hill. Once an airliner passed directly overhead. The pilot idled both motors but flew on, having failed to see him. Kurtz tried once to take off directly into the gale. As he picked up speed on that almost fatal attempt, he suddenly came upon a deep ravine; as he groundlooped the ship suddenly at its edge, the wind unexpectedly picked up one wing and carried him around through a 180-degree arc, to safety. On the second day, searchers found *Yankee Boy*, safe and sound, and on the third the wind abated so Kurtz could take off for the Pacific Coast.

Shortly after winning his private pilot's license, he was skimming up and down the Pacific Coast, occasionally with passengers. With only thirty-five hours' flying experience, he undertook, in a plane capable of nearly 200 miles an hour, to set the world's junior land-plane speed record, which he accomplished on a three-kilometer course at Seal Beach, Calif. Though officially clocked at only 125 miles an hour, he could have flown considerably faster. That record still stands, awaiting assault by some other young flyer.

WHILE not superstitious, Kurtz carries with him on all flights a mascot presented to him during a recent trip to Australia. It is a toy koala bear, which he has named Nippu Ji Ji, or "Early Morning Sun." The little bear has traveled around the world with him once, to Europe twice. With Kurtz, little Nippu Ji Ji has flown 25,000 miles, in a dozen types of planes and under all conceivable conditions. The young pilot may dump gasoline, oil, and maps to lighten his load when approaching a high mountain range, but Nippu Ji Ji continues to ride in the cockpit, lending moral support with its fighting pose to the daring young pilot.

Kurtz is now planning longer and more difficult flights. He trains faithfully on the springboard and in the air. Diving keeps him ready for the coming Olympic Games. Yes, he's a champion athlete, too. World's champion high diver in 1934, and holder of several international, European, and American championships, he also has gained fame as an Olympic Games diver.

A splendid physique acquired on the springboard already has brought him fame. Now he seeks new worlds to conquer—in the air or in the water

TRAILERS CREATE ARMY OF MODERN GYPSIES

(Continued from page 32)

teen miles to the gallon without the trailer, his mileage dropped to fourteen with the unit attached to his car. His oil consumption remained the same. He averaged 350 miles daily, in ten hours' driving, including all stops.

In a recent test with a streamline trailer, built along airplane lines, Hawley Bowlus, the famous sailplane designer, actually increased his car's mileage more than three miles to the gallon. His 1,100-pound trailer eliminated the drag, or air suction, of the car by its streamline form. He achieved the "airplane effect" when he reached a speed of thirty-six miles an hour, when it felt to the driver as though the trailer had dropped off. In fact, many drivers told me they drive as fast with a trailer as without. On more than one occasion, trailers have followed in the wake of the towing car at speeds in excess of seventy miles an hour.

YOU will find your travel costs are just about what you make them. They depend, in part, on the distance you drive. Ralph N. Jordan and three relatives left Beloit, Kans., in August, traveled 7,100 miles through Nebraska, Wyoming, Montana, Idaho, down the Pacific Coast, and back home through Texas two months later, in a trailer costing $325; they spent sixty-five dollars for gasoline and oil, $125 for food and twenty-five dollars on incidentals—a daily average, exclusive of the purchase price, of ninety cents per person.

Given a trailer, where can you park? The answer is—anywhere. Alongside the highway, on a country lane, at virtually any service station, or in one of the thousands of special parks for trailer tourists.

In Washington, Oregon, and California alone, 1,000 trailer camps are now being prepared, a recent survey by the Automobile Club of Southern California shows. Camp operators are convinced "trailerites" are going to take to the road in droves. And they're getting ready to supply, at costs ranging from twenty-five to fifty cents a day, a level place to park car and trailer, with no backing out required; sanitary conveniences, shade trees, water, and service plug-ins so their visitors may have electric current.

Soon you will be able to roll out of your garage, no matter where you live, and find accommodation at the end of each day's journey.

Trailer owners already have become gregarious. An average of 500 trailers daily were parked in San Diego, Calif., during the recent exposition. Again in California, forty or more trailers frequently take to the highway for a two-day mass picnic. Members of the "Travel-Ome Club," founded by R. T. Baumberger, who started building trailers as a hobby, take jaunts of 200 miles or more between Friday night and Monday morning.

ACROSS the continent at Sarasota, Fla., is the largest trailer park in the world. Last summer, 947 units were parked on its grounds during the annual trailer convention. Those attending last year's convention registered from forty-two states, plus the District of Columbia and four Canadian provinces.

Sociologists look on the tremendous increase in trailers as indicating a fundamental change in attitude toward the traditional obligations of home life. "It may not be amiss," said O. T. Kreusser, director of Chicago's Museum of Science and Industry, "to predict that if present trends in buying cars or buying homes continue, an increasingly large part of the population will live and carry on their home and business pursuits more around the automobile and less around a house as a fixed abode."

Already, tens of thousands spend their winters in the South, migrating like birds to the North when spring comes, and living on wheels virtually the year 'round.

MACHINES ARE TEACHERS IN PUSH-BUTTON MUSEUM

(Continued from page 15)

showing how geological forces build the world. The "strata" are layers of sponge rubber, weighted down by hundreds of tiny steel balls.

Touching a black button causes a miniature earthquake to be generated by a shaking table. First the primary or deep-seated waves, then the secondary or surface waves, are created, finally merging as they are reflected like mill-pond ripples from remote depths of the earth. A seismograph traces these undulating movements in red lines upon a strip of waxed paper, and, at the end of the demonstration, feeds the tape into the hands of the observer, to be torn off and kept as a souvenir.

A model volcano, partially cut away, reveals how molten rock wells up from the earth's core and overflows through a narrow tube or vent. A realistic miniature oil field, dotted with tiny workers, model derricks, trucks, refineries, and storage tanks, tells the story of petroleum.

IN THE foreground, the earth is sliced away. Down through the underlying strata, a column of light representing a drill darts arrowlike until it strikes a domed oil formation beneath. Yellow light, representing natural gas, shoots upward, then changes to red as oil spurts forth. A second well goes down near-by, lower on the dome. It, too, is a gusher, but soon the pulsing red light turns to green, indicating that salt water has displaced the oil. A third well is sunk still lower on the dome but finds only salt water. The oil has been exhausted and all three wells are dead.

The very mountains upon which the observatory is built open themselves for inspection. At the touch of a button, sections of a scale model rear themselves up for examination, revealing the underlying strata. A series of drawings shows how the mountains were built, from the time when primeval volcanoes belched forth acres of lava and cinders, to the later scourings by rivers, inundation by ancient seas, and final uplift by powerful subterranean forces.

Laws of physical science are revealed in operation by other robot lecturers. The drama of the celebrated Wilson cloud experiment, in which the electron finally was tracked down and "weighed," reënacts itself before the eyes of the spectator. A piston descends in a cylinder, expanding the air above it and thus cooling it. Into this rarefied air, tiny alpha particles, shot off by a bit of radium, smash at high velocity like balls from a Roman candle, leaving white tracks like tracer bullets.

Light is analyzed and "fingerprinted" by the visitor as he visits the optical section. Beams of light, passing through narrow slits, trace clear-cut "rays" as they pass through revolving combinations of concave and convex lenses, producing geometrical diagrams that illustrate the laws of optics. Gases at low pressure, glowing under the passage of electricity, give off colored light which is "assayed" by the observer as he peers down through a series of tiny spectroscopes, each no bigger than a fountain pen.

ELECTRICITY works silent miracles as black push buttons actuate relay switches. A copper sphere, floating in water, spins vigorously as invisible magnetic fields, created by induced currents flowing through the ball, play about it. Thus is illustrated the principle that operates the electric meter in your basement.

An aluminum ring the size of a saucer lies atop a spool wound with countless turns of copper wire. Suddenly it leaps a foot into the air, as induced magnetic fields affect it.

By the time a person has played with all the fascinating toys in this collection, he has seen a host of physical laws dramatized in a way that is a real scientific education.

MYSTIFYING STUNTS FOR THE AMATEUR CHEMIST

(Continued from page 51)

should be washed thoroughly to remove all traces of the chemicals.

Making fingerprints without ink is a chemical stunt that proves baffling to the uninitiated. The subject's finger is first placed on a "stamp pad" consisting of a cloth saturated with a colorless chemical solution: the impression is then made on what appears to be ordinary white paper. A sharply defined blue-black print results.

To prepare the paper, heat about twenty parts by weight of citric acid with about ten parts of starch and ten parts of water, until the reaction is complete and the liquid has lost most of its milky appearance. Thin the product with water and use it to coat the paper, which should then be well dried.

THE stamp pad is made of several thicknesses of finely woven white cloth, folded to the size and shape of an inking pad. It is thoroughly dampened with a solution consisting of about three parts of sodium nitrite or potassium nitrite—not nitrate—and one part of potassium iodide or sodium iodide, dissolved in about 700 parts of water.

The magic fingerprint that is produced when the subject's finger is pressed upon the damp cloth pad and then upon the prepared paper looks as if it were made with ink, although all the materials used are colorless. Actually the citric acid on the paper, reacting chemically with the nitrite chemical carried on the finger, liberates free iodine from the iodide salt. The free iodine, in turn, reacts with the starch to create the dark-blue coloration.

Invisible or "sympathetic" inks are easily prepared in an amateur laboratory. Cobalt chloride crystals, which are supplied in most home chemistry sets, may be dissolved in water, and writing made with this solution will be invisible. Warming the paper "develops" the secret message; the writing turns blue and is easily read. When it is breathed upon or exposed to moist air, it becomes invisible again. A small amount of ammonium chloride added to the cobalt chloride solution enhances the effect. Ammonium chloride may also be used alone as a sympathetic ink. Other substances exhibiting the same property include cupric bromide, copper sulphocyanide, cobalt nitrate, cobalt sulphocyanide, weak sulphuric acid, and most of the organic acids—for example, acetic acid and nitric acid

While it may not strictly fall within the field of chemical magic, a novel preparation that you can concoct from easily obtainable ingredients has curious and practical applications. This liquid will enable you to transfer cartoons, text, and other printed matter from newsprint to any other paper desired. It contains substances that soften the inked parts, together with other ingredients that perform the roles of pick-up and adhesive.

TO MAKE this preparation, dissolve one ounce of white soap flakes in one quart of warm water. Then add to the solution one half pint of turpentine, one half teaspoonful of aromatic spirits of ammonia, and ten drops of kerosene.

The resulting mixture is simple and clean to use. Moisten the cartoon or other newspaper item with the liquid, which should first have been shaken well in its bottle. Now turn the printed face down upon the paper to which the transfer is to be made, and rub the back of the damp print vigorously with a rounded instrument such as the bowl of a spoon. This causes the transfer to take place. Several impressions may be taken from the same picture, and pictures in colors as well as in black and white may be transferred. The method is inapplicable, however, to pictures on glossy paper, which do not transfer well.

BRITAIN'S GIANT SUPERLINER MARKS TRIUMPH OF MARINE ENGINEERING

(Continued from page 18)

The new queen of the seas will have twelve decks, of which the promenade deck, 730 feet long, is equal to the overall length of the historic *Mauretania*. The first-class dining room of the *Queen Mary*, the largest ever designed for any ship, will accommodate 800 people, and could be used as a dry dock for the old *Britannia*, the first Cunarder, which had one twentieth the bulk of its gigantic descendant of 1936. To feed all the passengers and crew will take 200,000 pieces of crockery and 100,000 items of tableware.

Other public rooms on this floating hotel will include the main lounge, cocktail lounge, smoking room, writing room, foyer, gymnasium, squash-rackets court, veranda cafes, private dining rooms, Turkish, electric-ray, and curative baths (reached by four elevators), massage rooms, two large swimming pools, and a shopping center. How passenger liners have developed is shown by the fact that only four of the twelve decks will be filled with first-class suites and bedrooms. To decorate these rooms and the rest of the ship will cost $2,500,000; to cover the floors will require ten miles of carpets.

THIS ultimate in luxury liners is laden with still more superlatives. There are special garages, so that motor cars may be driven aboard and parked for the voyage. Passengers may also bring their dogs to be housed on the top of the ship in twenty-six new-type kennels. This dog hotel is steam-heated and air-conditioned, and has hot and cold running water, a diet kitchen, and attendants to exercise the lucky dogs. It is likely to be filled most of the time, for the Cunard White Star Line alone takes a thousand canine pets a year across the ocean and back.

Lest all these new gadgets confuse the passengers, there is still one more to help them know where they are. All they need do, is glance up at the big colored map of the North Atlantic, high on the forward end of the vast dining room, and pick out a small, lighted model of the ship, as it moves twinkling across a painted ocean. The ship has 596 clocks, electrically operated and controlled by two master clocks on the bridge. And if, somewhere in 3,000 miles of ocean, danger should threaten, all the latest safety aids are ready.

There is not only radio, but a new-type ship-to-shore radiotelephone system that will make conversations absolutely secret. This will bring the ship's station into line with the transatlantic telephone services having similar secrecy devices. The ship will carry submarine signaling apparatus, instruments to record the depth of water under the hull, a wireless direction finder, and powerful searchlight projectors.

A NEW device is the special type of siren that will give the ship a "voice" to warn away smaller craft. The sirens will be toned to two octaves below middle "A", and will be so powerful that they can be heard ten miles away. Yet, to the passengers right beneath their brazen throats, they will not sound as loud as a penny squawker. To fight the dread threat of fire at sea, this floating caravansary will be subdivided by many fireproof bulkheads designed to keep any blaze within small limits, and also will have a fire-detection and extinguishing plant. And if, at last, passengers and crew should be forced to abandon the greatest of all ships, there will be ready twenty-four unsinkable steel motor lifeboats, each holding 145 persons.

Six months before the *Queen Mary's* maiden voyage, 1,500 people had applied for the 775 first-class cabin accommodations available. Already it is rumored that the Cunard White Star Line is proposing to designate the *Queen Mary* not a "first-class" but a "cabin-class" ship—the new and popular name for "second class." That would mean that the *Queen Mary* would charge less to the passenger, perhaps even $100 less, than other superliners, and so, supposedly, draw more passengers. There was talk of the *Normandie* and perhaps, the North German Lloyd liners *Bremen* and *Europa* taking the same step.

Some American shipping men call this a move to lure away to bigger European ships, the "popular-price" tourist trade from the American liners *Washington* and *Manhattan* and the new liner the United States Lines have just started, to replace the *Leviathan*. There is also talk of asking Congress to appropriate $50,000,000 to build two American-flag superliners to beat the *Queen Mary*, *Normandie*, and all the rest.

A tentative plan for these liners, is to build them in such a manner that they could be readily converted into troopships, with a landing deck for airplanes provided by lowering the funnels and the masts. The *Queen Mary* and all the superliners would be extremely valuable in war time to the nations possessing them, as troop transports, and this has been taken into account in designing and building them. There is provision for mounting guns and discharging aircraft to protect them from attack, especially by fast, long-range bombing planes.

TO MAKE more interesting the bloodless "naval war" of today among the superliners, there are warnings that it may be all in vain. In a few years, say some air experts, the superliners of the sea will be doddering along behind the superliners of the air; transoceanic long-range express seaplanes, taking passengers, mail and freight from continent to continent with safety and tremendous speed. The *China Clipper* flights across the Pacific point the way, these say. A three-day service between California and the Orient looms in the near future. Pan-American Airways and Imperial Airways are negotiating for round-the-world connections. Other interests are planning a twenty-four-hour air service between New York and London.

Will the stupendous, superlative *Queen Mary* prove to be not only the latest, but the last, of all superliners?

ODD EARTHEN JARS MADE PIRATE BOMBSHELLS

EARTHENWARE shrapnel in the form of jars with pointed projections like thorns were recently exhibited at the Field Museum of Natural History in Chicago. These queer bombs were used by Chinese pirates in the days when they terrorized the China Sea. Filled with gunpowder, sulphur, nails, and shot, the jars were sealed at the top and placed in calico bags, closed by a draw string. Known as "thunder stones," they were carried aloft in a basket at the masthead of the pirate ship. In making an attack on a merchantman, the thrower, in his station in the basket, would first insert three or four lighted incense sticks inside the bag and tighten the draw string. When the bomb landed and smashed on the deck of the attacked ship, the burning incense ignited the powder and sulphur, scattering the shot and a suffocating sulphurous gas.

HUGE NUGGET OF GOLD UNEARTHED IN RUSSIA

A FORTY-NINE pound nugget of gold, the largest discovered anywhere in the world during the twentieth century, has just been found by prospectors in the Ural Mountains of Russia.

CHECK YOUR WIRING FOR CARE-FREE DRIVING

(Continued from page 56)

I took the bulb out and put it back, and the light came on again. I guess it was just dirt under the spring contact."

"It was dirt, all right," Gus explained, "but not the kind of dirt that gets in from the outside. The dirt that did that job was corrosion right on the surface of the solder on the bulb contact."

"I always thought a soldered joint was the best of all," protested Hillon.

"It is," Gus agreed. "If you twist two wires together and flow solder into the joint, neither time nor any amount of vibration will ever cause that joint to let go.

"BUT this isn't a soldered joint," Gus went on, pulling open one of the headlights and removing the bulb. "The wire from the filament is soldered to this brass tab on the base of the bulb, but the socket contact presses against a lump of solder instead of against the brass. In time, corrosion on the surface of the solder either breaks the flow of current or puts enough resistance in the circuit so that the light won't be quite as bright as it ought to be.

"Back in the early days of radio, vacuum-tube sockets were made just like this—the spring contacts pressed against a lump of solder on the end of each prong—and if you didn't take the tubes out and sandpaper the prong ends once in a while, the radio got to sounding like a lot of hens scratching on a tin roof.

"You won't find a single radio-tube socket made that way today. The contact is always against the side of the prong, and until the auto-lamp makers follow in the radio makers' footsteps, you'll find it a good idea to take every bulb on your car out of its socket at least once every few months and sandpaper the contacts."

"I'll certainly do that hereafter," Hillon decided. "That will eliminate a lot of my troubles."

"A large part of 'em, at any rate," Gus agreed, "but not all. Remember, perfect connections won't make current flow if there's a break in the line somewhere else. And it won't flow where it's wanted if there's any shorter path it can take by way of a short circuit.

"Vibration is the enemy of every electrical wire on your car," Gus went on. "I'll bet we can find several places where it'll only be a question of time before a wire will chafe through and either cut off the current or cause a short circuit that may leave you stranded."

"Show me," Hillon ordered. "Aunt Eliza can wait!"

"All right," Gus agreed, pulling up the floor boards. Let's start with the storage battery. Here's one place where you're more likely to have trouble from corrosion than from vibration—unless the battery gets loose in the box, and then you'll have a bad combination of both. Take a look at that ground cable."

"PRETTY messy looking, isn't it?" Hillon observed. "I suppose the acid from the battery ate away the strands like that. Still, there seems to be a lot of the cable that is all right."

"It'll do for three or four months," Gus decided, "but I wouldn't let it go longer. By that time enough of the strands will be eaten away to increase the resistance and cause hard starting, and if you forget about it, you'll likely find yourself stuck on the road some night with no power and no lights either."

"The starter cable looks all right, anyway," remarked Hillon. "I don't see much corrosion there."

"Looks don't mean much," Gus grumbled. "Sometimes the corrosion sneaks in under the insulation. We can tell easy enough. If the cable still is in good *(Continued on page 132)*

CHECK YOUR WIRING FOR CARE-FREE DRIVING

(Continued from page 131)

shape, it will be strong and stiff. If it is badly corroded inside, where you can't see it, it will bend easily at that point. It may even break off in your fingers."

Gus reached down and gave the cable a strong pull first one way, then the other. No weakness was apparent.

Rapidly they went over all the other connections, one by one. The wire to the stoplight switch had broken loose from its moorings and was dangling in such a way that it was rubbing against the frame and the insulation was slowly wearing away; one of the headlight wires was chafing against the edge of the radiator core, and the wire leading to the generator cut-out was working loose.

"HERE'S a little point that is worth remembering," Gus pointed out, as he fished out his screw driver again. "When you find a loose connection like this, don't just tighten it. Remove it and scrape it clean with your knife or a bit of sandpaper, then clamp it down tight and it'll be as good as new. A fellow doesn't need a fancy set of tools to keep the wiring system in dependable shape. With a little sandpaper, a screw driver, a pair of pliers, and a roll of tape, most anyone can stop this sort of trouble before it starts.

"The main thing is to take the time out to give the wiring a thorough check and when you see something showing signs of wear, fix it right then and there—and fix it right.

"These stitches in time," continued Gus, as he straightened up after replacing the floor boards, "will save your temper because you won't be held up like this and some day it might keep you from running into an expensive repair bill."

"Aren't you nearly ready?" Mrs. Hillon greeted them as she walked in with the twins.

"All finished," Hillon replied. "Hop in and we'll get going.

"I guess this is doomed to be a noisy day," he chuckled in an undertone to the garageman, as he handed him a bill. "We listened to that blamed horn all morning, now we'll have to listen to Aunt Eliza most of the afternoon."

MAJOR CHANGES TO MARK CARS OF NEXT DECADE

TEN years from now, motorists will drive six-wheeled, tear-shaped, streamline cars which have air conditioning, rear-end motors, self-inflating tires, and dual gas tanks, according to Austin M. Wolf, prominent automotive engineer. Present body styles will give way to the most efficient streamline shape, he believes, and air-conditioning apparatus will cool engine and brakes as well as maintain a comfortable temperature in the car interior. The 1946 models will have six self-filling tires, two front and four rear. Engines will be located in the rear over the driving wheels. In cold weather, cars will start with light, volatile fuel from one tank and then automatically switch over to regular gas when the engine warms up. Red and green lights will replace most dashboard instruments, the red lights flashing to indicate trouble in the ignition, lubricating, or cooling systems.

SYNTHETIC TUBES TAKE BRINE FROM SEA WATER

BRITISH scientists have just perfected a new process for converting sea water into fresh water, pure enough to drink. Ocean water is pumped through a series of synthetic-resin tubes containing chemicals which absorb the metallic, alkaline, and acid-forming impurities. Although safe to drink, the treated water has a slightly unpleasant taste but will be suitable for many industrial purposes.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

SIMPLE RULES HELP TO BEAUTIFY YOUR LAWN

(Continued from page 46)

binations of these. Sow one pound of any rye grass to 100 square feet, one pound of clover to each 150 square feet, one pound of blue grass, poa trivialis, or red top to each 200 square feet, or one pound of bent grass to 300 square feet.

Fertilize immediately after seeding. Best results will be obtained by using a weed-free, cotton-fed steer manure. One sack containing sixty-seven pounds will cover 200 square feet adequately. You may broadcast it by hand on a new lawn or with the back of a rake over a renovated lawn. Spread evenly, only deep enough to cover the seed.

ADEQUATE water is most important in making a new lawn. Sprinkle with a fine spray immediately after fertilizing. Do not allow the lawn to dry until the grass comes up. Water three or four times daily, if necessary, until all of the grass is above the ground, then once a day until it is cut the first time.

Most grasses will require cutting after the third week. Then, they should be cut only when trimming is needed, excepting bent grass which should be cut twice each week. Cut bent grass as short as possible, but do not cut any other type of grass shorter than three-fourths inch. Otherwise, the surface roots may be sunburned and the soil surface will lose moisture.

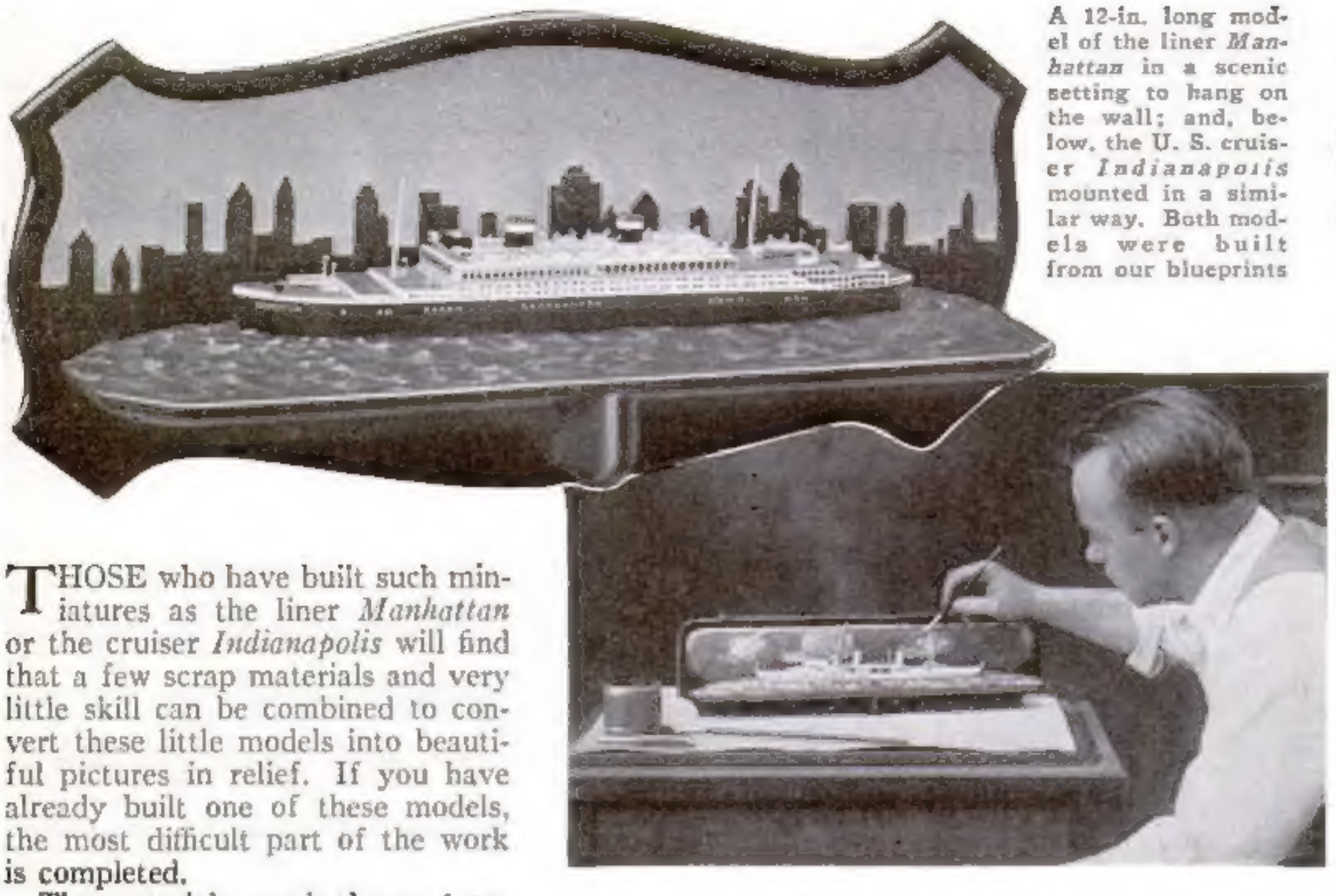
Foreign grasses will intrude in even the best lawn whenever permitted to get a start. Of these, the four worst offenders are the Johnson, crab, devil, and English goose grasses. These can best be eliminated by early weeding and by using a weed-free fertilizer. A solution consisting of five pounds of iron sulphate in ten gallons of water for each 100 square feet, sprinkled when necessary, will help control dandelions and the wide-leaf grasses, such as crab and Johnson. Also frequent fertilization during the growing season with sulphate of ammonia will create an acid condition in the soil and help control dandelions, which demand a sweet soil.

Bent grass and, in a lesser degree, blue grass are subject to brown patch. This may be controlled by spreading sulphur trioxide, preferably as a mixture, using fifteen pounds of the chemical in 100 pounds of weed-free fertilizer. This quantity will cover 1,700 square feet effectively. To make sure the sulphur trioxide reaches the roots, puncture the soil with a fork at intervals of one inch to a depth of three inches. This will enable water to carry the fertilizer down to the root system.

NITRATE of soda or sulphate of ammonia will restore a rich green color to a lawn more quickly than any other method. Sprinkle one pound of either chemical to each 100 square feet over a dry lawn. Water at once thoroughly, otherwise the grass will burn. This treatment will bring out the grass in three days, but it should not be attempted more frequently than once during a season.

Finally, to restore a dry lawn, such as may result during a vacation, you will get best results by applying a balanced fertilizer—preferably organic—in order to build up the soil and give it the required food. Blood meal, fish meal, cotton-seed meal, and tankage (waste) contain the needed elements. All these are organic but each carries a different amount and type of food. Balanced fertilizer can be prepared by any nurseryman and should carry five percent of nitrogen, ten percent of phosphoric acid, and two percent of potash. A mixture containing fifty pounds of bone meal, forty-five pounds of blood meal, and five pounds of sulphate of potash is adequate to cover 2,500 square feet, and will provide a proper diet for the ailing lawn.

MOUNTING MINIATURE SHIP MODELS



A 12-in. long model of the liner *Manhattan* in a scenic setting to hang on the wall; and, below, the U. S. cruiser *Indianapolis* mounted in a similar way. Both models were built from our blueprints

THOSE who have built such miniatures as the liner *Manhattan* or the cruiser *Indianapolis* will find that a few scrap materials and very little skill can be combined to convert these little models into beautiful pictures in relief. If you have already built one of these models, the most difficult part of the work is completed.

The materials required are: 1 pc. ⅜-in. three-ply board 8 by 18 in. for panel; 1 pc. ⅜-in. pine 3½ by 16⅛ in. for shelf; 1 pc. ⅜-in. pine 1½ by 3 in. for bracket; a small quantity of light blue, dark blue, and white artist's colors, some black or silver paint, a little walnut wood stain, and about ½ lb. of plaster of Paris.

For the liner *Manhattan* we might visualize a background of towering buildings. Cut the three-ply board to the shape of the back panel shown or, if you prefer, make the board oval, rectangular with rounded corners, or any other suitable design. To this panel fasten a shelf with a small bracket in the center for support. This gives you the foundation.

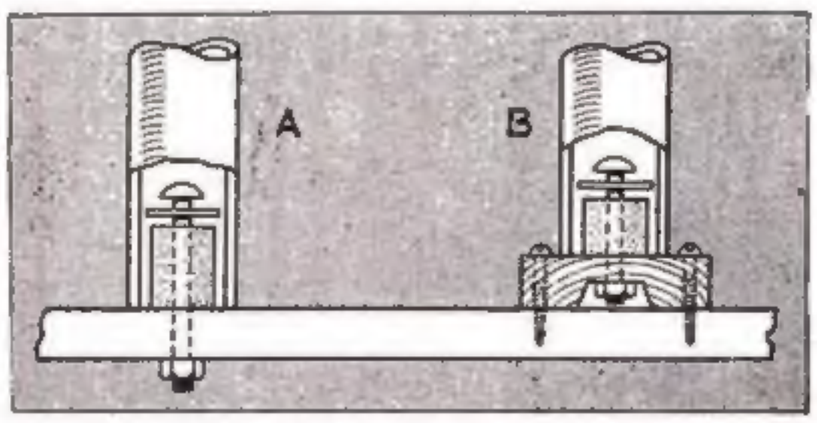
The sky line is cut from 3/16- or ¼-in. cardboard and glued firmly to the back. Buildings cut from thinner cardboard can be glued to the front of the sky line to give the appearance of varying depth. The entire sky line may be painted a dull black or silver with a sky of light blue in back.

The model is next placed in "water" made from plaster of Paris. It is well to give the shelf several coats of shellac before applying the plaster so that the board will not warp as it absorbs moisture from the plaster. The water should not be rough as a harbor is ordinarily quite calm. Paint the water a dark blue with occasional white caps and a suggestion of foam at the stern of the boat. The shelf and the border of the panel are stained dark.

Other models may be treated in a similar manner, with backgrounds appropriate to the type of ship. The second example illustrated is a 12-in. model of the U. S. S. *Indianapolis*, shown as if at sea.—ROY E. PETERSON.

HOW TO FASTEN BENCH LEGS OF PIPE

LENGTHS of pipe make serviceable bench legs and supports for equipment to be used in the shop or garage. If the ends are threaded and floor flanges are at hand, the legs may be fastened easily to the floor, wall, or bench top, but difficulty arises when flanges are unobtainable or the cut length of pipe cannot conveniently be threaded. In that case, one of the methods illustrated may be used.



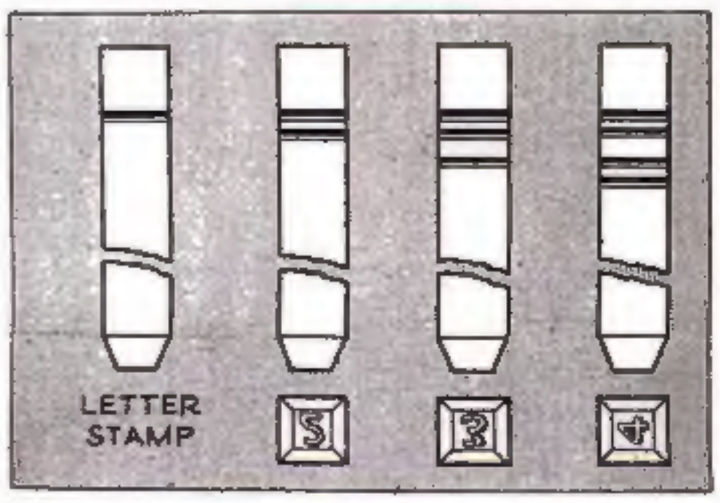
A carriage bolt is inserted into the end of the pipe, head first, and a washer, nearly as large as the inside of the pipe, is added. Then a short length of garden hose is slipped over the bolt. The leg is set in place, and the bolt is thrust through a previously bored hole in the bench top or flooring, as shown at *A*. Tightening a nut on the bolt will draw the head downward, compressing the hose and making it grip the sides of the pipe tightly.

When a nut cannot be applied to the opposite side of the supporting surface, the bolt is fastened to a wood block, the bolt hole of which is counterbored so that the nut does not protrude. The block is then nailed or screwed to the wall or floor as shown at *B*.—W. C. WILHITE.

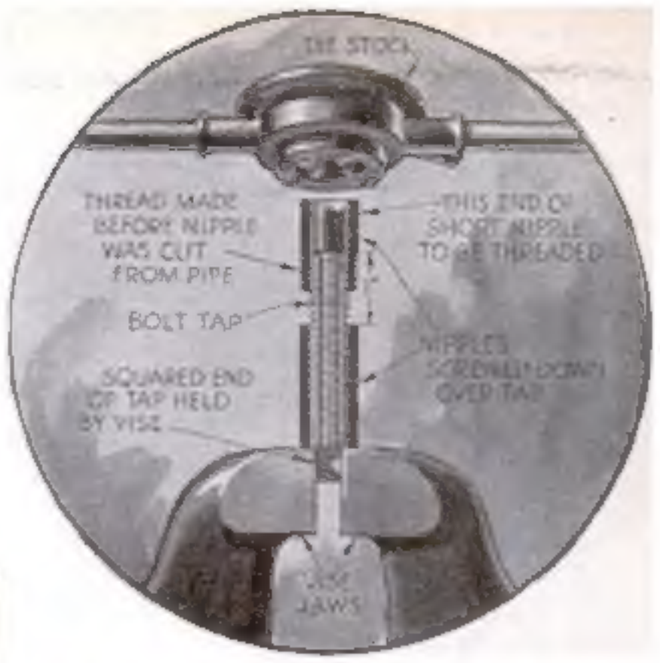
METAL STAMPS MARKED WITH NOTCHES

LETTER and figure stamps used for marking metal may be handled more rapidly if notches are ground in the side that will face the user when the punch is held in the correct position. This eliminates the necessity of noting the position of the letter or figure on the end of the stamp.

Letter stamps require only one notch, but figure stamps should be notched according to the number on each. The figure six stamp should have six notches; and in using it to stamp the figure nine, it must be held so that the notches face away from the user.—THOMAS TRAIL.



The notches show which way the stamps are to be held and also identify the number stamps



EASY WAY TO THREAD SHORT PIPE NIPPLES

THE amateur mechanic who lives some distance from a plumber frequently faces the problem of making a pipe nipple that is too short to be held in the vise and cut with his regular dies. The usual detour around this difficulty—that of running a long thread on a piece of pipe and then sawing off the length desired—leaves much to be desired, as long straight threads often tear and always lack the taper that is so essential to tight joints.

Select a bolt tap of the nominal diameter of the desired pipe and clamp it vertically in the bench vise to serve as a mandrel. This will enable the cutting of true all-thread, double taper nipples that will be as good as the commercial article. A spacer of the same pipe is screwed on the tap to bottom against the vise jaw and still leave about an inch of the tap thread exposed. One thread of the nipple is formed before it is cut from the long length of stock pipe; the nipple is then screwed, threaded end down, on the bolt tap in the vise, and the die is run over the unthreaded end in the usual manner. The spacer serves to guide the die and insure straight threading.

The slight spiral cut within the nipple by the bolt tap may be dressed with a file, although usually the running of a swab with white or red lead will fill the groove and prevent early rusting from occurring at that point.—ELTON STERRETT.

• • •

TO PREVENT a knot tied in a rubber band from slipping, try the application of a drop of benzine.—O.B.

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